

# First Look at Falcon's New Convertible

# POPULAR SCIENCE

SEPTEMBER 1962 • 35c Monthly

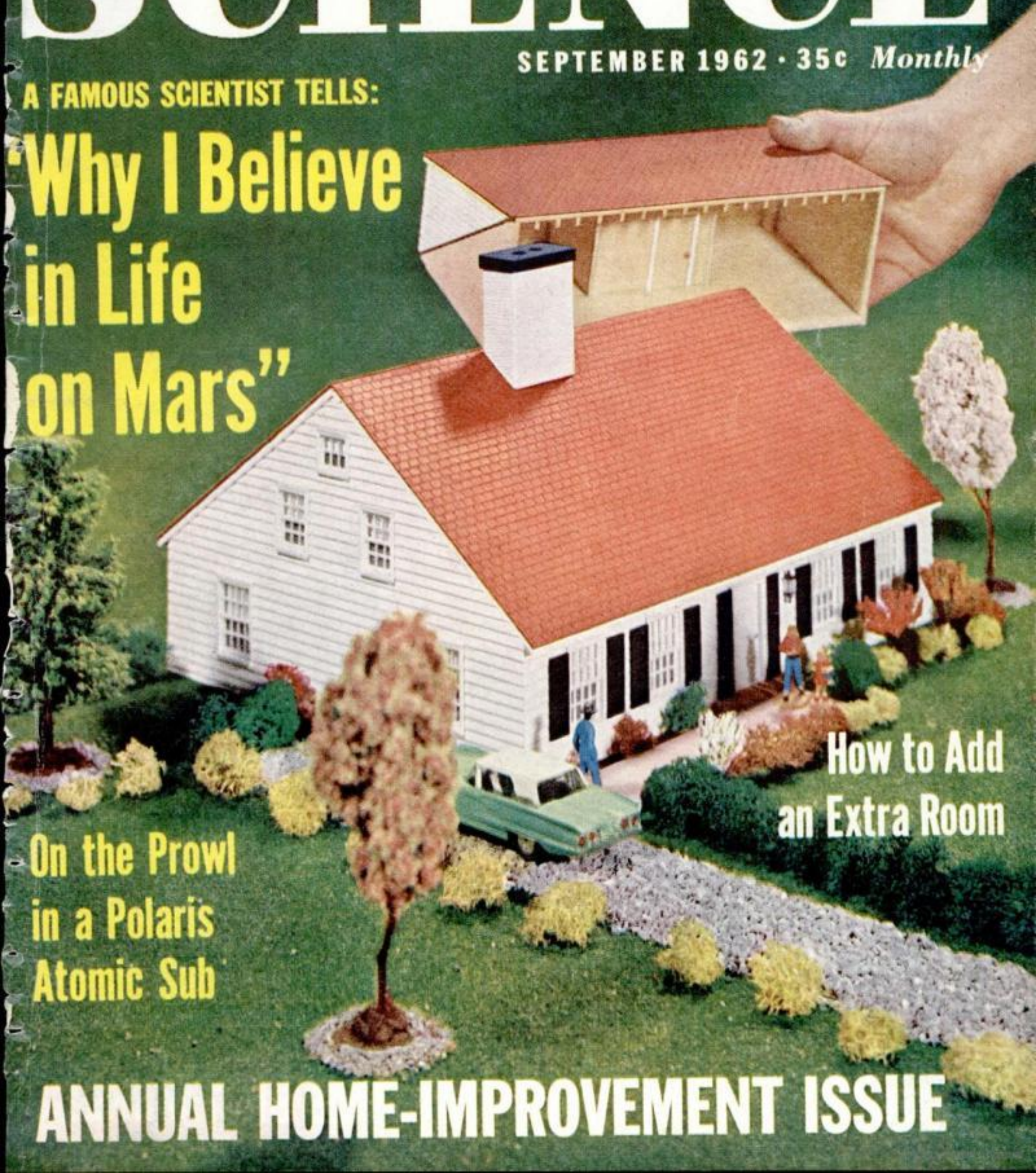
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"Why I Believe  
in Life  
on Mars"

How to Add  
an Extra Room

On the Prowl  
in a Polaris  
Atomic Sub

ANNUAL HOME-IMPROVEMENT ISSUE





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# Turner

## PROPANE TORCH

Like a liquid fuel rocket, the fuel tank of a Turner torch contains bottled energy. This disposable Turner fuel tank holds enough liquified petroleum gas for hours and hours of work. The Turner Torch lights as easily as a kitchen stove and instantly becomes a clean, hot burning fuel (2300° flame). With its many uses, the Turner torch has a place in every home.

LOOK AT THE JOBS A TURNER TORCH WILL DO IN YOUR HOME. Solder, Light charcoal, Remove rusty bolts, Free frozen car locks, Remove putty, Soften asphalt tile, Repair gutters, Brown meringue on a pie, Thaw frozen pipes, Remove paint, Antique woods.



### NEW LP88 TURNER TORCH KIT WITH HANDY CARRY TRAY

The new LP88 Turner Torch Kit not only carries your torch to the job, but other tools as well. Kit contains carry tray, torch, full fuel tank, soldering tip, hot cut tip, flame spreader and spark lighter.

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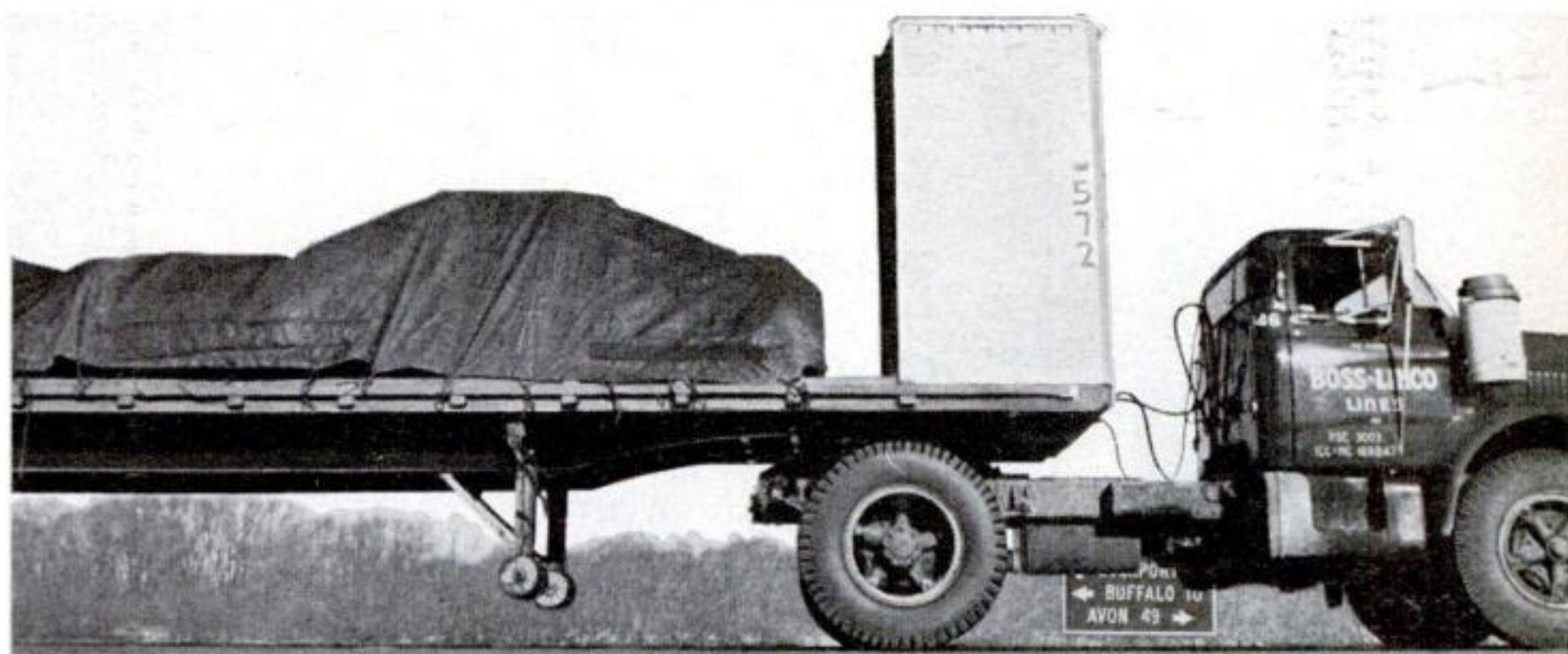
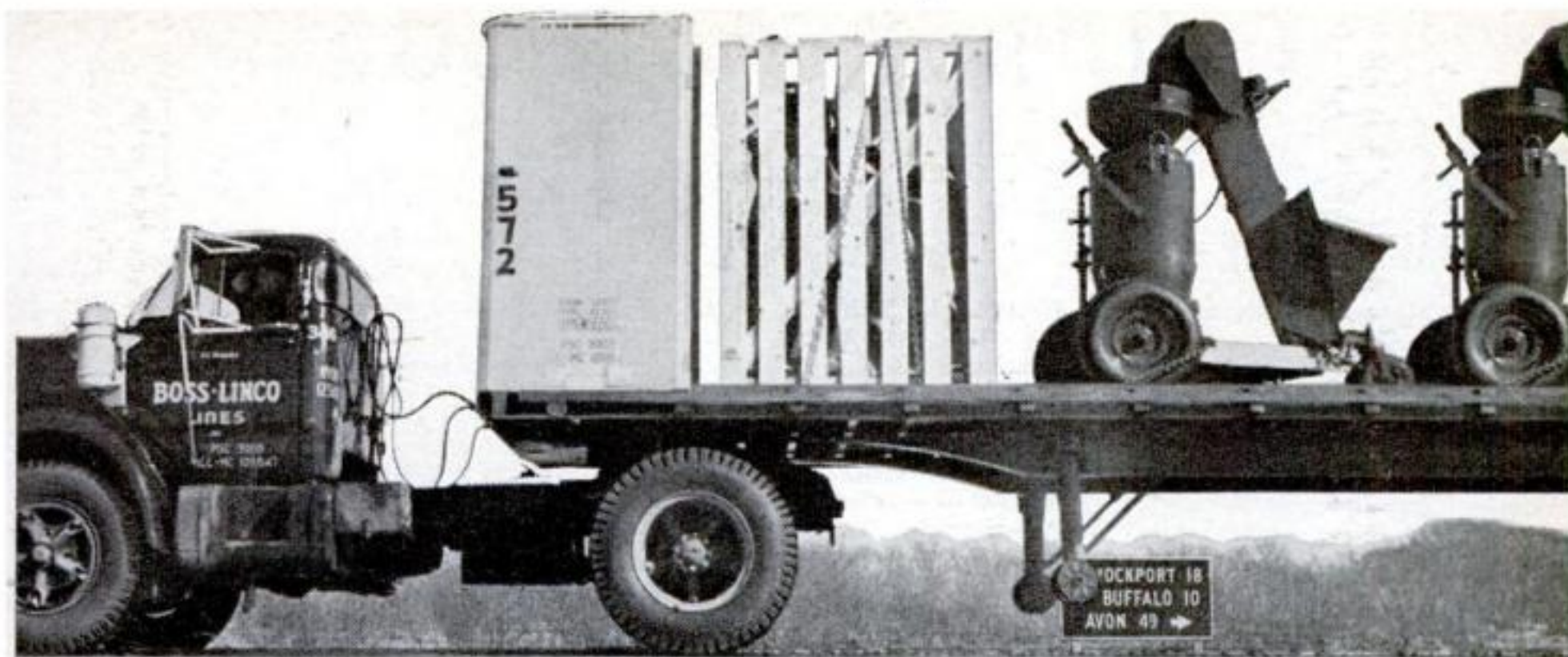
# Turner Corporation

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## New tire brings you back "free"!

One inescapable thing in trucking is that a "run" means a "round trip."

You have to figure *most any* truck tire will get you there and back. But Goodyear's new Super Cross-Rib truck tires get you back "free"!

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in ordinary tires. The outer tread is super-toughened to run farther. The inner tread is more resilient to restrict flexing and reduce heat buildup—a major cause of tire failure.

So when you think of any "run," think of Super Cross-Rib. The cost of getting there is the same. Super Cross-Rib gets you back "free." See your Goodyear Dealer or Goodyear Service Store today. Goodyear, Akron 16, Ohio.

ANOTHER REASON WHY: MORE TONS ARE HAULED ON GOODYEAR TIRES THAN ON ANY OTHER KIND

# GOODYEAR



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**September 1962**

Cover photo by W. W. Morris



*Come aboard this Polaris-armed atomic sub for a ride with a PS reporter. Page 59.*



*Amazing feat of engineering: 59-story Pan Am Building goes up over a railroad—while trains are running. See page 67.*



*Thirsty? That's an SOS that your body's salt balance is out of line. Page 82.*

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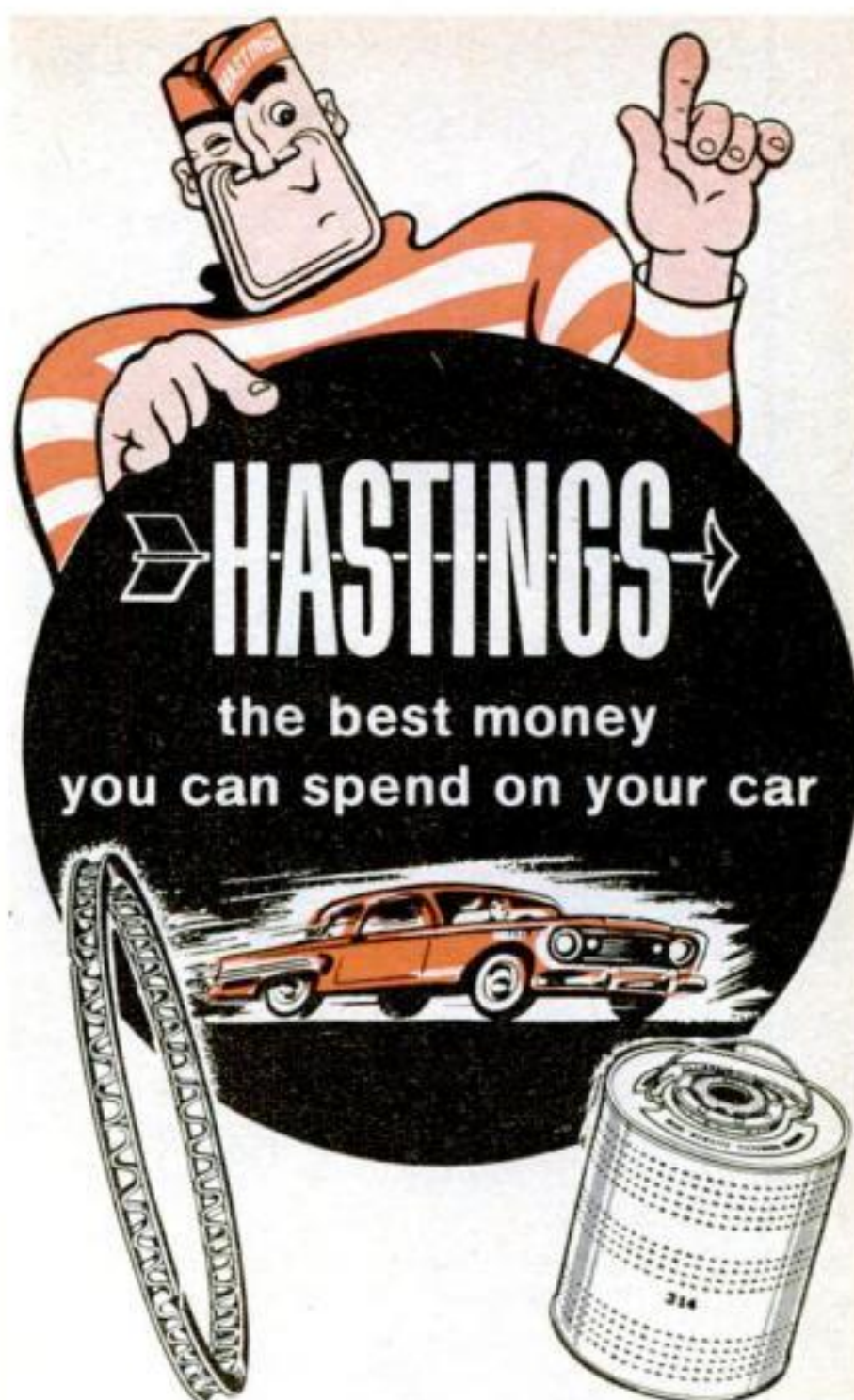
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# PS readers talk back



## Imitation—Sincerest Flattery

The dynamic seascape you used as an introduction to "What to Do If Your Outboard Conks Out" [July, p. 110] made a very effective opener. However, it showed poor taste and no originality to distort a fine work of art in this manner. Your picture could be nothing but a retouched reproduction of Winslow Homer's "Gulf Stream."

J. D. STEPHENS, Monticello, Fla.

*The illustration was not a "retouched" copy. An artist was commissioned to redo the famous painting, changing the sailboat to an outboard. Homer is one of our favorite artists. If he were still alive, we'd have asked him to do it.*

## Cranking Out Figures

That 80-year-old cylindrical slide rule ["Numbers in the Round," June, p. 194] was an old familiar friend. I operated an old "squirrel cage" like that way back in 1911 at the Shenango mine, in Chisholm, Minn. The computer was used to obtain the average con-

tent of iron-ore shipments while enroute from mine to shipping port. This called for endless addition, multiplication, and division, which the squirrel cage did handily and accurately.

Another computer used was the "Dutchman," a mechanical machine made in Germany. It did good work but was noisy; the operator hand-cranked it. It could get out of order and make serious errors. The faithful squirrel cage had no parts to get out of order; any error was one of operation, and not mechanical.

H. O. WHITE, Amberg, Wis.

## Directions Are for Following

That tester for flash bulbs ["Tips from the Gadget Bag," June, p. 130] looked simple enough. I decided to test a bulb I suspected of being defective. It was. Then I tested a newly purchased M5 flashbulb and got two burned fingers when the bulb flashed.

When I went back to the article, I discovered that it specified the use of a light bulb from a one-cell penlight—I'd used a two-cell job. When I used a lamp from a smaller pocket flashlight, I had no trouble using the same 1½-volt battery.

The lamp is critical. Any maker of the tester should be warned: Use the lamp from a one-cell penlight as specified.

T. W. CHANDLER, Waynesboro, Va.



## Lazy-Man's Player Piano

Last year after reading the article on how a player piano works [Sept., p. 95], I purchased an old player. Since then, with the help of your article and data in the local library, I've completely overhauled my piano. It was 35 years old and not in working condition.

To make it a lazy-man's piano, I powered it with a used vacuum cleaner. To minimize the cleaner's noise, the vacuum is in the cellar and a flexible hose runs through a hole in the wall

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# "HOW A 'CRAZY RUMOR' GOT ME PROMOTED!"



**What I overheard one morning shook me right out of a rut!**

"Company's getting ready to cut back . . . bound to be layoffs," I heard them say. "Just another crazy rumor," I told myself.

Just the same, I took quick stock of myself that night. Came up with four good reasons why the company would keep me on:

*Three years' experience*

*Getting along with foreman*

*Turning out acceptable work*

*Prompt and dependable*

And four just-as-good reasons why they might let me go:

*Making no real headway*

*Others better qualified*

*Still rated "semi-skilled"*

*Needs special training*

I wasn't in trouble. But I sure wasn't "in solid" like I should be. That's when I made up my mind to enroll for training with I.C.S.

I picked I.C.S. because it's the oldest and largest with over 250 courses. The training is quick and thorough. It's recognized by my company and accredited by the National Home Study Council. You study in your spare time and get personalized, practical instruction—know-how you can apply next day on the job.

That was a year ago. There have been two layoffs since then. While some of the others were just hanging on or being released, I was moving up. My I.C.S. training started something. Not only did it get me promoted (with a fat pay hike), but it put me in line for real advancement.

Don't wait for a "crazy rumor" to set *you* straight. Take out your "job insurance" right now. Mail the coupon and get full, free details on how I.C.S. has helped thousands, how it can help you. No obligation—and you get three valuable booklets *free!* (1) How to Succeed; (2) Catalog of opportunities in the field of your choice; (3) Sample lesson.

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- ☐ Painting
- ☐ Plumbing

### ART and DESIGN

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- ☐ Fashion Illustrating
- ☐ Interior Decorating
- ☐ Magazine Illustrating
- ☐ Show Card & Sign
- ☐ Painting
- ☐ Sketching and Painting

### AUTOMOTIVE

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- ☐ Auto Electric Technician
- ☐ Automobile Mechanic
- ☐ Engine (Gas & Diesel)
- ☐ Engine Tune-Up

- ☐ Transmission Specialist

### AVIATION

- ☐ Aero Engineering
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- ☐ Aircraft Mechanic

### BUSINESS

- ☐ Accounting
- ☐ Cost Accounting
- ☐ Public Accounting
- ☐ Bus. Administration
- ☐ Executive Training
- ☐ Marketing
- ☐ Personnel-Labor Relations
- ☐ Programming for Digital Computers
- ☐ Purchasing Agent
- ☐ Real Estate
- ☐ Salesmanship
- ☐ Sales Mgmt.
- ☐ Small Business Mgmt.
- ☐ Traffic Mgmt.

### CHEMICAL

- ☐ Analytical Chemistry
- ☐ Chem. Engineering
- ☐ General Chemistry

- ☐ Lab. Technician
- ☐ Nuclear Energy
- ☐ Plastics
- ☐ Pulp, Paper

### CIVIL ENGINEERING

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- ☐ Construction Engrg.
- ☐ Highway Engineering
- ☐ Reading Structural Blueprints
- ☐ Sanitary Engineering
- ☐ Structural Engineering
- ☐ Surveying & Mapping

### DRAFTING

- ☐ Architectural
- ☐ Electrical and Electronic
- ☐ Mechanical
- ☐ Sheet Metal

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- ☐ Electrical Engineering
- ☐ Elec. Eng. Technician
- ☐ Elec. Motor Repairman
- ☐ Industrial Electronic Technician

- ☐ Industrial Telemetering
- ☐ Instrument Technician
- ☐ Practical Electrician
- ☐ Practical Lineman

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### MISCELLANEOUS

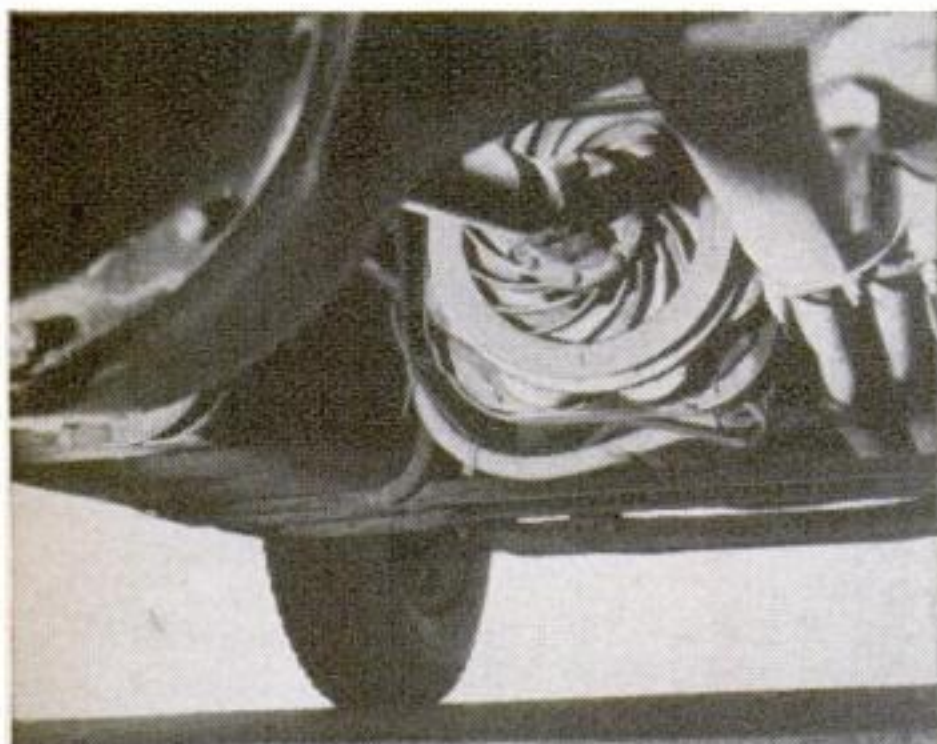
- ☐ Railroad
- ☐ Textile
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## QUICK QUIZ BY QUAKER STATE



1. Can you name this device often found on trucks and buses?



2. What does this symbol stand for?

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and back of the piano. The hose is connected to low-air reservoir.

To prevent the cleaner from producing more power than required, I gradually added quantities of spun-glass air-filter material to the cleaner bag, until about 1½ p.s.i. vacuum resulted.

R. R. COYLE, Lockport, N. Y.

### Who Needs It in California?

You think General Motors' smog chamber is "probably the only thing of the kind in the world" ["Detroit Report," May, p. 48]? Scientists at the University of California's Citrus Experiment Station, in Riverside, have had smog chambers in operation for at least six years.

DON BUBLITZ, San Francisco.

### Case of the Cocky Cub

The example of an upstate farmer flying his Cub at Idlewild Airport ["The Other Fellow's Job," June, p. 102] is a bit ridiculous. It is



highly unlikely, although with two-way radio such a plane could legally use the airport. Teterboro handles such traffic for the New York area.

Furthermore, should a Cub be given the same runway ahead of a jet, it would be 1,000 feet off the ground at about the point the jet would break ground. The controller probably would bend the Cub 45 degrees to right or left as soon as it is in the air to clear the way for faster planes. This has been my experience on large airports (not Idlewild) and I've never held up any airliner for more than a minute.

TOM ROOT, Plymouth, Ohio.

Small private airplanes rarely use Idlewild. But it can and does happen. There's a funny tale (true, we believe) about the time a glider tied an airport up in knots: Gliders have right-of-way over powered craft, just as sailboats do in the water, and this cloud-happy glider-rider took advantage of the rules to land at LaGuardia—one of the world's busiest commercial airports.

### No Flash in the Pan

We were pleased to see the piece on our Sun Gun Professional Photo Light and M-3 Flashbulb ["What's New in Photography," June, p. 153]. You refer to the Sun Gun as a type of flash gun. It is small enough to be mistaken for a flash gun but, in fact, it is a high-powered photo light that can take the place of many enormous studio lights. Far

CONTINUED



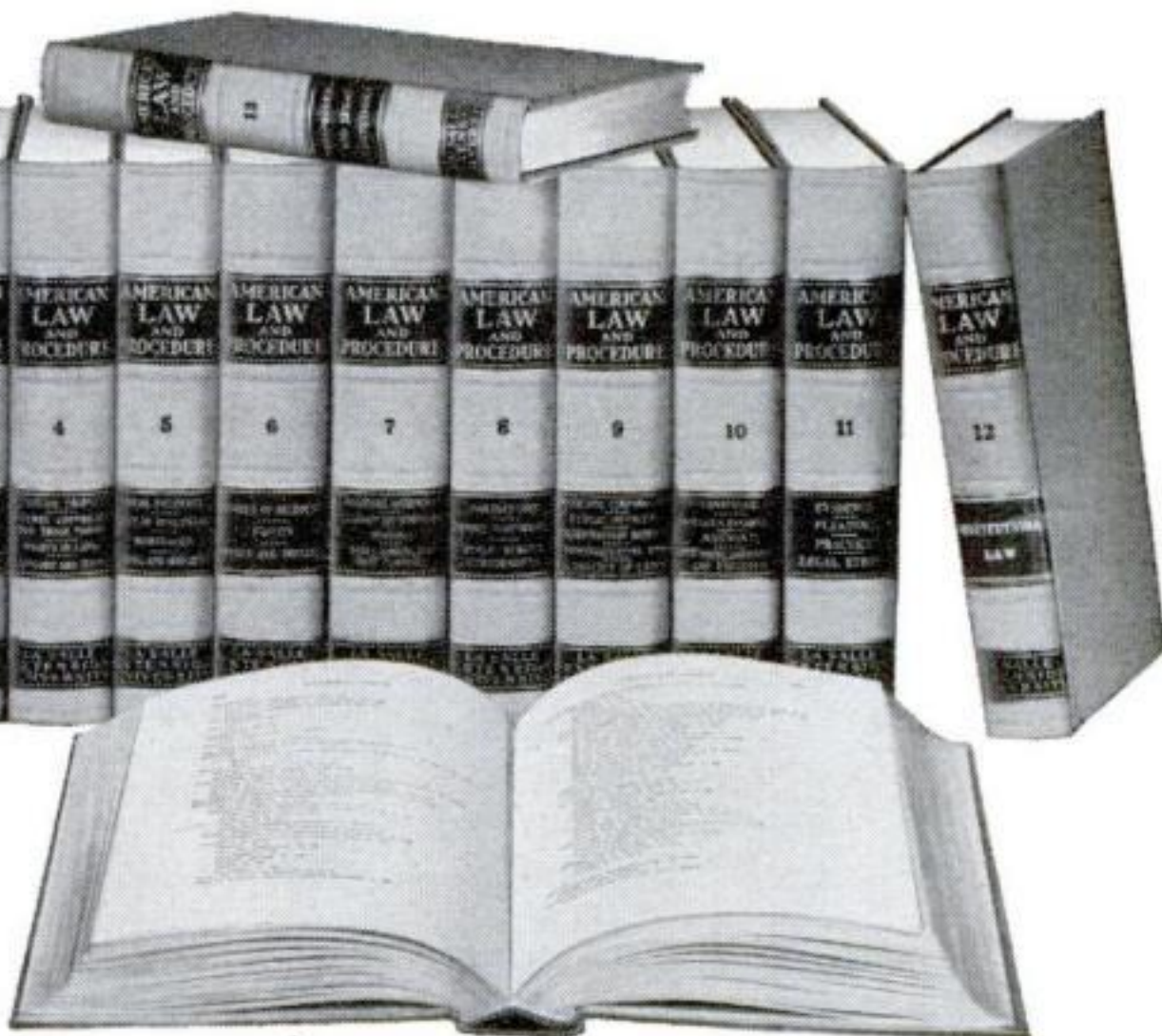


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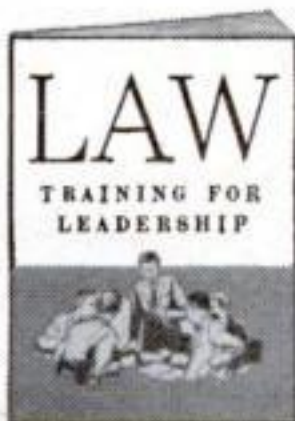
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### Caught in the Halyard

Someone should tell Gail Lewis ["PS Readers Talk Back," June, p. 8] that there are many ropes on sailing vessels. Among them: bell rope, bolt rope, bucket rope, top rope, head rope, foot ropes, boat rope, man rope. Enough?

ART SMITH, San Francisco.

### Let Us Keep You Informed

In "How to Seem Informed Without Really Trying" [June, p. 64], you say the fastest passenger elevators in the world are those in the RCA Building in New York. As the engineers responsible for the design of the vertical transportation in the new Chase Manhattan Building in New York, let us keep you informed: The elevators in the Chase Building rise a total of 765 feet at a speed of 1,600 feet per minute, or 18.2 miles per hour.



G. CATTABIANI  
Meyer, Strong & Jones, NYC.

... You say that the Golden Gate Bridge is the longest, but you don't qualify this in any way. What about the Lake Pontchartrain Bridge near New Orleans?

G. L. DUNCAN JR., Jackson, Miss.

... Surely the Mackinac Bridge in Michigan is now the longest suspension bridge?

MRS. RAY ROBERTS, Sherwood, Ohio.

*The Golden Gate Bridge is the longest suspension bridge, with a main span of 4,200 feet. The main span of the Mackinac Bridge is 3,800 feet. The Lake Pontchartrain Causeway—24 miles long—is not a suspension bridge.*

### Scare for Tire-Puncturing Vandals

This is my suggestion for the man who has a tire-puncturing nut in his neighborhood ["PS Readers Talk Back," May, p. 18]:

Get a leveling mercury switch. Connect it to the car's horn so that any tilt caused by the deflation of a tire will cause contact to be made and blow the horn. He'll have to adjust the level of the switch each time he parks where the tire puncturer operates. A driving cutout switch will be needed, of course.

J. J. NEUMAN, Yorktown H'ts., N. Y.

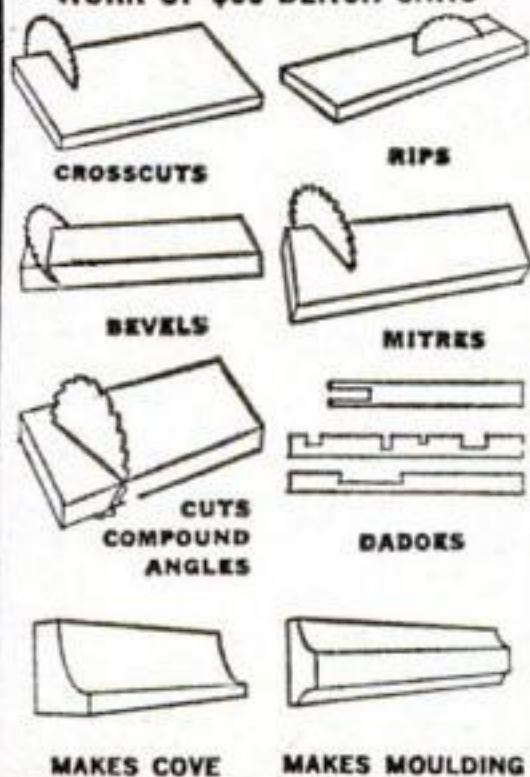


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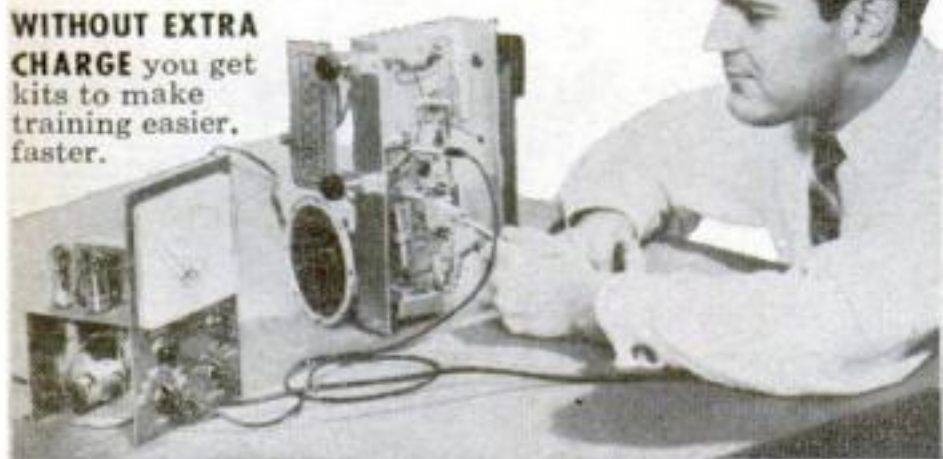
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JACK SOUTHCOTT, Waycross, Ga.

### A Slow Starter

In reprinting from old issues ["75, 50 and 25 Years Ago," June, p. 32] you sure pulled a boner when reporting the electric blanket as a 1937 news item. A UPI notice of the funeral of Samuel I. Russell, in June, credited him with invention of the electric blanket in 1912. Mr. Russell, chairman of the Northern Electric Co., died at the age of 76.

JOHN R. FOY, Redlands, Calif.

Our 1937 item reported a new product on the market and gave no indication of the date of its invention. Many a new patent gathers dust for years until the public is ready to accept it. And when the product goes on the market, the money may roll in to the holder of a new and much later patent.

### Anyone Own a Buckboard?

While moving some junk from a building in which my brother once had a business, I found what I believe to be a fiber ring, appar-



ently in unused condition, for the friction drive of an Orient Buckboard. My brother once owned one of these vehicles and I remember we frequently had to replace the fiber ring on the rim of the wheel that engaged the disk on the flywheel.

The ring has a 16-inch o.d., 13½-inch i.d., and is about an inch thick. There are 12 holes for ¼-inch bolts equally spaced around the circumference for attaching the ring to the driving wheel. Anyone having any use for this ring can have it by paying transportation.

R. C. HUNT, Chatham, Va.

### Hotter Hot Ones

Your Alex Markovich ["Test-Driving Stock-Car 'Monsters'," May, p. 64] calls the Chevy 409-hp. job the "hottest hot one," says it ran 0-60 m.p.h. in approximately 6.7 seconds. He seems to find this nothing short of astounding.

CONTINUED



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But: The test of the Pontiac 405-hp. Grand Prix indicated it could run 0-60 in 6.1 seconds. And in rainy weather, which naturally decreases the traction factor. I've heard reports of the Pontiac 405 engine, using a lower ratio rear end than the one on your test car, accelerating from 0-60 in close to five seconds flat. Try a report on one of those "monsters."

DAVID E. BECK, Middletown, Ohio.

## Kennedy Rocker Takes Ribbons

Last year, seven of our sophomore boys picked your Kennedy rocker [Jul., Aug., Sept. '61] for industrial-arts class projects. The con-



struction proved quite educational since it called for many general woodworking skills as well as many new operations such as wood bending and cane weaving. At a local industrial-arts fair, two boys—Ronnie Kelley and Bob Chadwell—won ribbons for their rockers.

W. W. GHAN, INSTRUCTOR  
Norwood H.S., Norwood, Mo.

## Hot Tip on Hot Jet

We read with great interest Frank Harvey's article, "I Rode Our Hottest Jet" [May, p. 53].

The APQ-72 armament control system for the Navy's F4H aircraft was designed and developed and is being manufactured by the Westinghouse Defense Center—not by General Electric. The 10,000 employees here would appreciate your bringing this error to the attention of your readers.

ROBERT A. DEASY  
Westinghouse Defense Center  
International Airport, Md.

## Old Engine Identified

The picture sent in by T. M. West ["PS Readers Talk Back," May, p. 16] is that of an engine used in small, portable cement mixers 25 to 30 years ago. It was a hit-and-miss affair. It would pop; then several seconds later, pop again. He can look it up in Dykes Encyclopedia of Engines.

STEVE CONKOVICH, Granite City, Ill.

... The little engine was used to drive both water pumps and cement mixers. And originally it did have a make-and-break magneto system.


F. E. SAUNDERS, Bovard, Pa.



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# The march of SCIENCE

By Martin Mann

## Transfer station above the moon

A new and hairy scheme looks like the most promising way to land Americans on the moon on schedule. It's called lunar rendezvous. Instead of shooting a huge spaceship direct to a landing, or assembling the ship from parts orbiting around Earth, this idea calls for a transfer of men and capsules just above the moon. It's dangerous but efficient.



The moon ship would blast from Earth toward the moon but not land there; it would circle in an orbit 100 miles above the moon. Two of the astronauts would then enter a small rocket called the "bug" and zoom away from the mother ship to land on the lunar surface—like sailors in a liberty boat going ashore from a battleship.

To return, the astronauts would blast the bug off from the moon and meet the mother ship in its orbit. They would transfer back, abandon the bug, and rocket home in the mother ship.

The main advantage is weight: Lunar rendezvous would reduce the total load to be blasted off from Cape Canaveral by almost half. One

standard C-5 booster, instead of two, could do the job.

The disadvantage is risk. If something went wrong in other lunar landing methods, the astronauts could probably get back to earth. If they missed the critical return meeting in the lunar rendezvous, they'd be gone for good.

## Secret of the universe—around the corner?

The most confused of modern sciences this summer became simultaneously a little more confused and a little clearer. That's the way it goes in particle physics, the fascinating search for nature's ultimate secrets: What is the universe made of? How does it operate? The Final Answer may be just around the corner.

The confusing clarification is the discovery of two distinct forms of the neutrino—one of the 30 or so basic building blocks of matter. This is confusing because it adds still another "elementary" particle to a weird assortment already too varied to understand. Yet it does offer the first hard clue to one of the fundamental forces of nature.

The neutrino has always been an oddball. It used to be called

CONTINUED



the atomic ghost because, for decades after its existence had been predicted, it couldn't be "found." It has no weight and no electric charge, and is the only thing in the universe unaffected by gravity. It can travel tremendous distances through any material before it gives itself away by bumping into another atomic part.

The neutrino is so elusive that direct experiments are just barely possible even with the most elaborate equipment. The discovery of the distinct neutrino types required an unprecedented 800 hours of operation of the world's biggest atom-smasher, the AGS at Brookhaven National Laboratory on Long Island. A cosmopolitan group of scientists (U.S., French, Greek, Indian, Canadian) from Columbia University worked six months and managed to catch 50 neutrino "events." (The Atomic Energy Commission picked up the tab, which ran over \$1,000,000.)

The Brookhaven-Columbia team used the AGS' powerful beam to smash atoms of beryllium. Some of the fragments changed into neutrinos, and a few of these ran into a detector called a spark chamber. The spark chamber was shielded, to screen out other atomic rays, by a 5,000-ton steel room with a wall 42 feet thick, made of armor plate from obsolete Navy ships. An incalculably vast number of high-energy neutrinos sped through the armor into the spark chamber. But workers could find evidence of just 50 that bumped into aluminum target plates there and knocked out other atomic fragments, which the chamber measured.

The scientists had expected that the neutrino-aluminum collisions would generate equal proportions of two kinds of atomic pieces: electrons and muons. But all they got were muons. They concluded that there must be one neutrino type that produces only muons, and another that produces only electrons.

This finding raises new hopes of understanding the "weak interactions." Neutrinos take part in weak interactions, a fundamental force that governs certain types of radioactivity. Further experiments—at Brookhaven and at Cern in Switzerland—may pin down the "W-particles" of weak interactions. Success would add still more pieces to the puzzle. But then again, it could also help clear up the whole mess.

### The permanent plastic pill

Two Navy doctors are working on a capsule that may dole out medicine inside the body steadily year after year. Instead of getting daily shots, a patient with a chronic illness—heart disease, diabetes, cancer, bone infection—would have implanted within him one capsule and never need another for five or six years. The pill, smaller than your fingernail, is made of Silastic, a silicon rubber that lets drug molecules leak through at a regular, very slow rate. So far, Drs. Judah Folkman and D. M. Long of the Naval Medical Research Institute at Bethesda, Md., have tried it only in dogs (to release heart-stimulating thyroid hormone). The big problem is that it works for a week—then a fiber coating builds up around it and clogs it.





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## The March of Science . . . continued

### Electric power without wires

The tantalizing old idea of beaming energy through air and space seems about to become a reality. A team at Purdue headed by wiry-haired, square-jawed Prof. Elias M. Sabbagh has adapted new microwave radio techniques to achieve remarkable efficiencies in power transmission.

Microwave tubes generate hundreds of kilowatts and—because the waves are so short that they can be sharply focused—much of this energy can be delivered to the receiver. The trouble comes in converting the extremely high frequency—500,000,000-plus cycles per second—to the 400 cycles or less that electrical machinery demands. Rectifiers can make the conversion, but were miserably inefficient at microwave frequencies. Now Prof. Sabbagh's group has improved both vacuum-tube and semiconductor rectifiers enough to get 60-percent conversion efficiency—at 40 watts.

This is a long way from what it takes to light a house. But it may handle offbeat jobs. For instance, power might be beamed at a satellite passing overhead, to operate heavier equipment than batteries could supply.

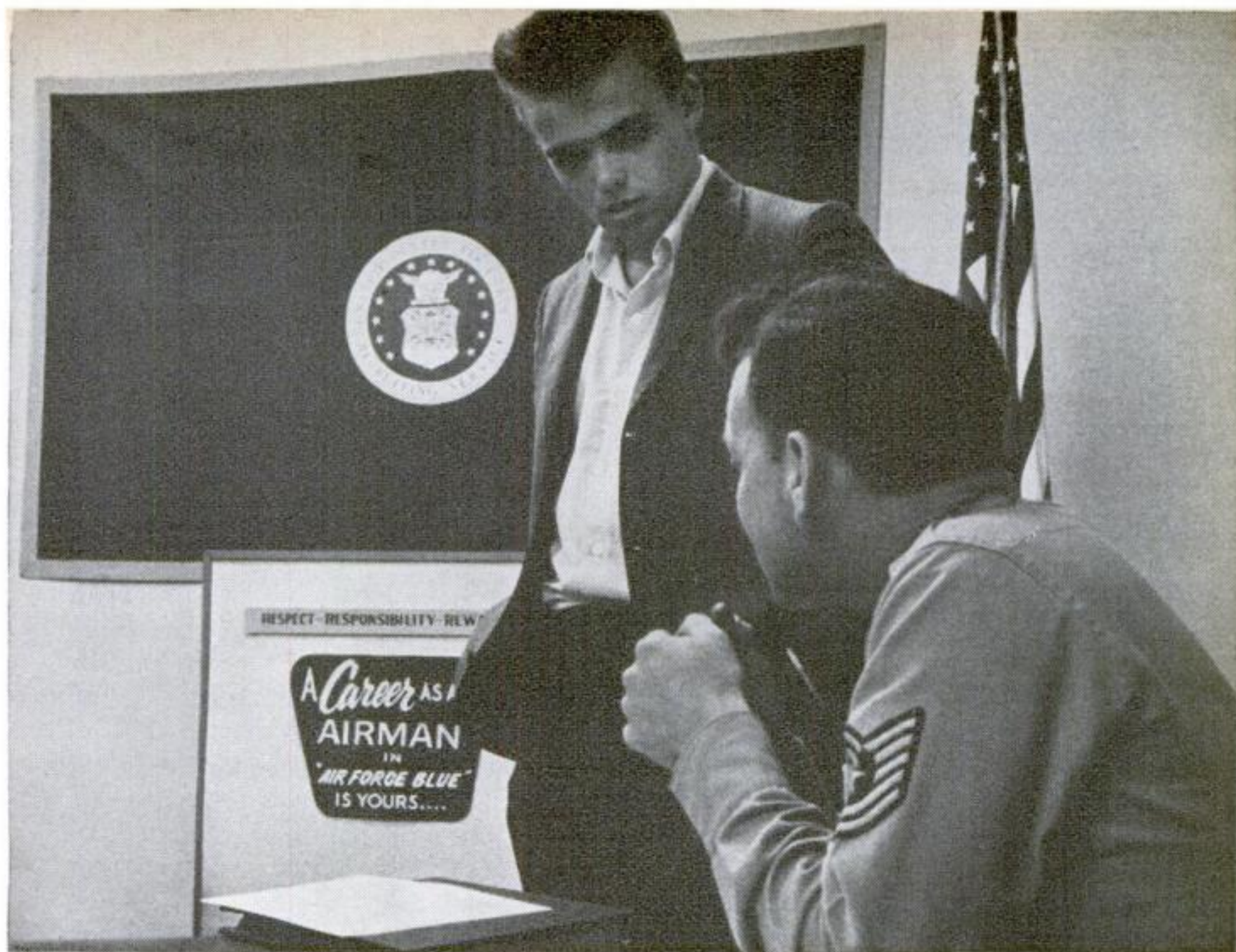
### Pasteurized water

Farmers now have a foolproof way to get pure water for their homes and barns, reports Charles O. Shults of the Warren Rural Electric Cooperative, Bowling Green, Ky. An electric pasteurizer takes pond water from a sand filter and heats it to 161 degrees for 15 seconds to kill germs. It handles 500 gallons per day, using about 25 kilowatt-hours of electricity. The big advantage over chlorination systems is the sure and simple operation.

### Make-believe violence turns real

Does a scene of a savage beating in a TV Western incite the audience to real-life savagery? A new test by Canadian researchers suggests the pessimistic answer that it may.





*Air Force Recruiter to Paul Looney, New Haven, Connecticut*

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### The March of Science . . . continued

The baleful effect of some "entertainment" is an ancient worry. And the only people who have examined the problem with more or less open minds—psychiatrists and social scientists—have reached opposing conclusions. Some say that fictional evil or violence lets the audience blow off steam harmlessly. Others say the audience is led to imitate what it has seen or read.

Solid evidence—on either side—is understandably hard to come by. But R. H. Walters, E. L. Thomas, and C. W. Acker of the University of Toronto and the Ontario Hospital tried this experiment:

They asked one group of volunteers to help with a "memory test" of a second group. The first group was to "punish" wrong answers from the second group by giving them electric shocks. The severity of the shocks was adjustable, and the first group was given a taste of the various shock levels. (The memory test was a fake, but the first group did not know that.)

Then half the first group was shown an innocuous movie about teen-age painting. The other half saw the switchblade fight scene from the movie *Rebel Without a Cause*.

The scientists wanted to know if the movies influenced the volunteers to change the severity of the "punishment" shocks they administered. There was considerable before-and-after difference. Those who watched the innocuous movie dealt out milder shocks than they had before. Those who saw the vicious fight sequence consistently dealt out stiffer shocks.

### Flu coming

Watch out this winter for Asian flu (technically, influenza strain A2). It's going to be a bad year, says the U.S. Public Health Service, which is pressing a campaign for inoculations beginning right now. One or two shots before winter are recommended, especially for the chronically ill, pregnant women, and anyone older than 45.



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John Jaffe: "There's a huge demand for good carpet and upholstery cleaning. If you tell enough people about Duraclean, you have to make good."

Hiram L. Brown: "Made \$105 in one day cleaning sorority house."

Thomas C. Mason: "Cleaned two rooms for a stock broker. He was so impressed he had 7 jobs lined up for me and from those seven came 4 more."

Russel C. Blue: "Customer called a prominent competitor. They said they could not clean her badly soiled furniture ... to contact me because 'if anyone could get it clean, I could'."

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L. Broersma: "Have now completed 5 years with Duraclean. We have never had one complaint."

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Almost every building houses a customer. Furniture stores, department stores, interior decorators, upholsterers and carpet stores secure jobs from their customers. Auto dealers have used cars Duracleaned and take orders for you. Some dealers have shops or offices ... others operate from home with no overhead expense.

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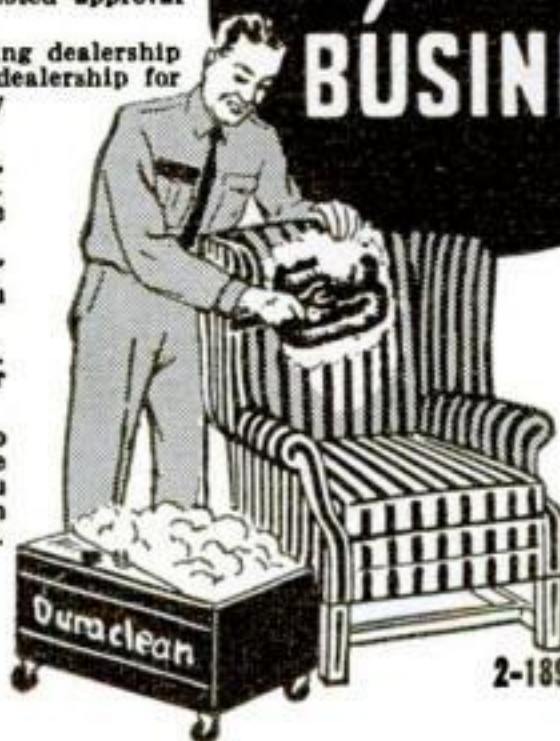
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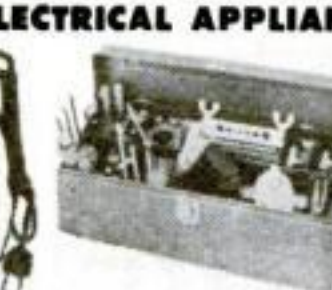
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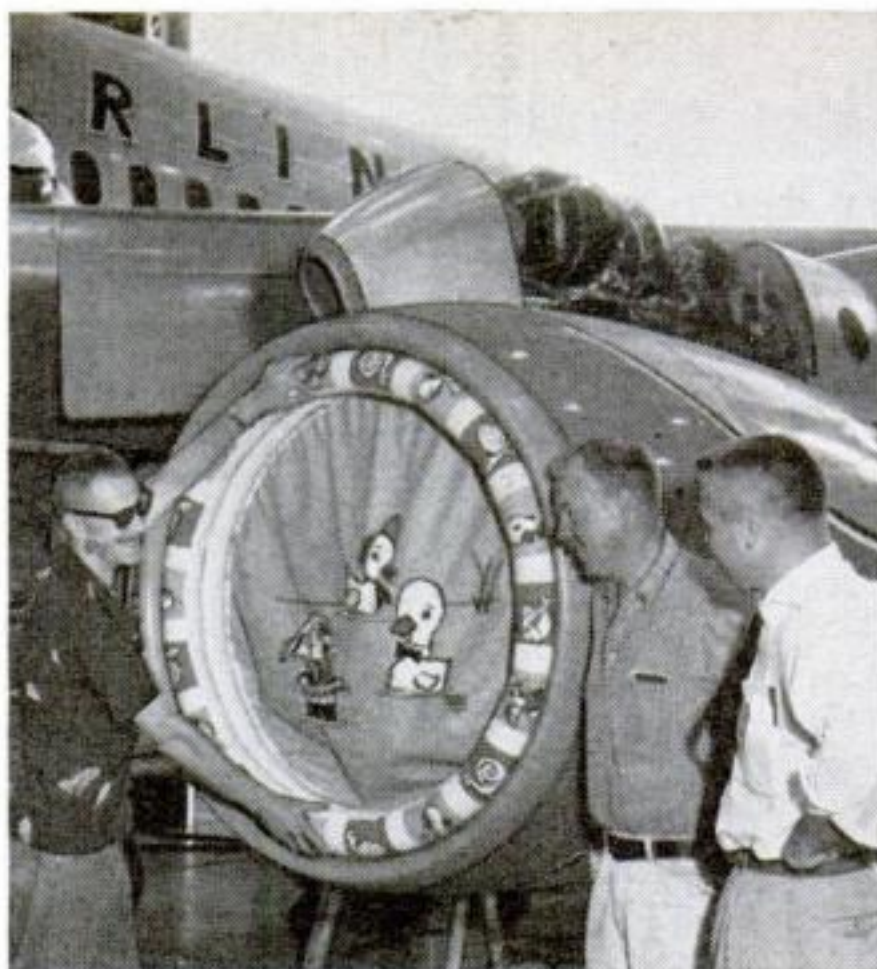
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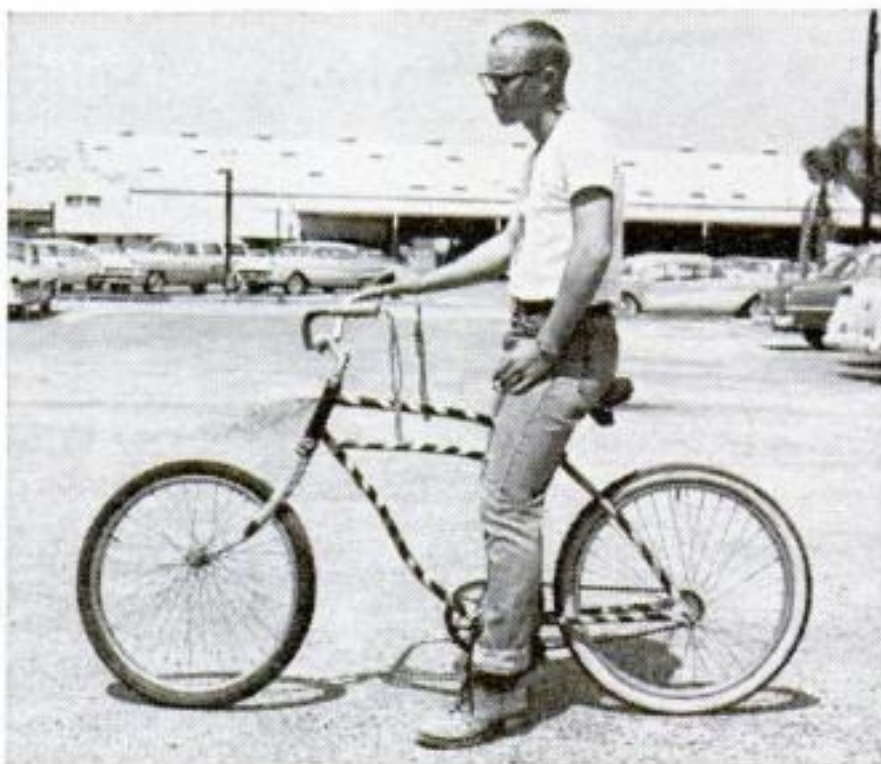
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## Play pool protects jet engine

A child's inflatable wading pool is being tried out here as a protective covering for the inlet of a jet-engine pod. N. M. Zodrow, Rohr Aircraft plant superintendent at Auburn, Wash., found it just fits and is cheaper than the plastic covers previously used on the nacelles his company makes for Pratt & Whitney jet engines.

Zodrow is now ordering the play pools in large quantities—and in plain colors.



## Eccentric-wheel bicycle

Off-center hubs on the wheels of the bicycle above give it a jumping motion not unlike that experienced on a bucking bronco. Put together by a Clearwater, Fla., bicycle shop, the odd bike makes a big hit when ridden in local parades.



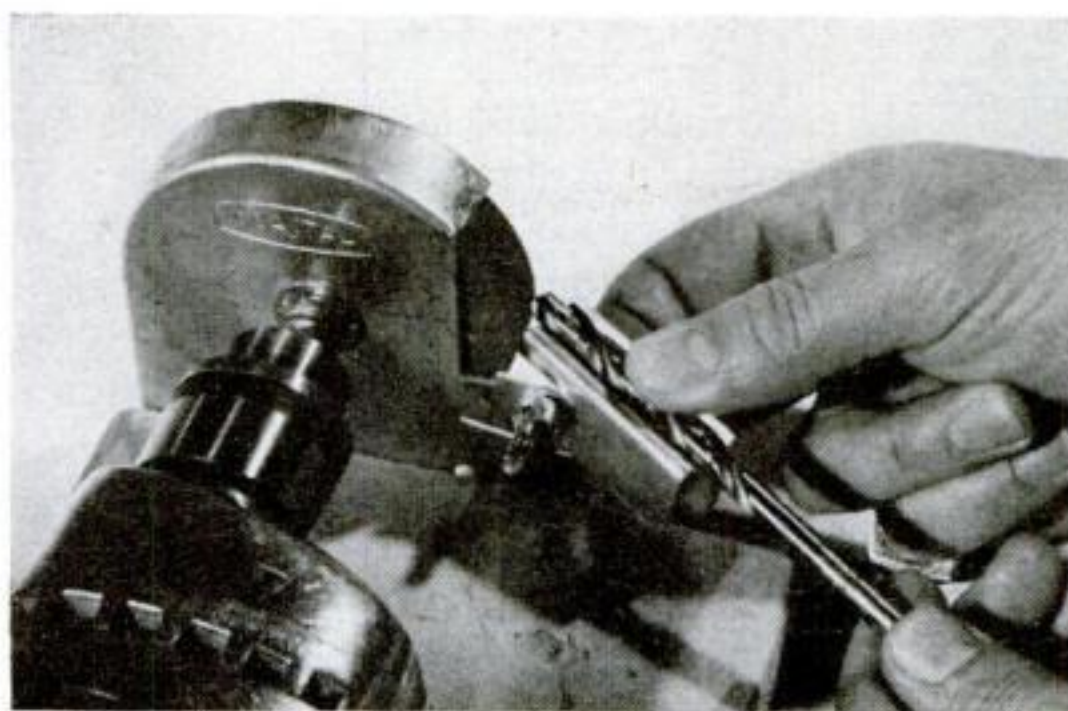
# SHOP TALK

By Sheldon M. Gallager



## Smart idea: A low-cost sharpener for drill bits

Got a little gadget in the mail the other day that caused quite a stir around here. For two bucks, it promised to sharpen old, dull drill bits automatically. We decided to give it a try. What it amounts to is a 3" aluminum oxide grinding wheel mounted in



a metal guard with a 1/4" shaft that can be chucked in any electric drill. The guard is screwed to the edge of a scrap block, and a V-shaped guide holds the bits against the wheel at the proper lip and relief angles. You simply feed a bit against the wheel for a light pass on each lip.

Tests were made on the oldest, dullest bits we could find, and the results, shown in the table at left, turned up some surprises. In all cases, the sharpened bits cut about as fast as new bits of equivalent size. Tests in deep holes also showed no tendency for the bits to cut oversize or out of true.

You don't, of course, get a true conical grind, because the

drill lips are held in a fixed position against the wheel and are thus ground flat. While this is less precise, it proved adequate for jobs not involving critical machinework. Our opinion: Considering what you pay, the tool is a handy shop accessory for quick touchup sharpening. It takes bits up to 1/2" and, with a supplementary guide, can also sharpen chisels and other blades. It's sold by Coastal Abrasive and Tool Co., 42-33 Northern Blvd., Long Island City, N. Y.

## Coming soon: Variable-speed shop tools

Ever wished you could slow down a drill or saw on some materials, then speed it up again for others? The old trick of inserting a light bulb in the circuit cuts speed, of course, but it also cuts torque, and you wind up with no power. Now the dream of a truly variable-speed shop tool is about to come true. GE engineers have come up with a silicon-controlled rectifier that lets you vary a motor's speed without losing torque. Best part is that

Drilling Times in 1/8" Mild Steel					
	BIT SIZES				
	1/16"	1/4"	1/4"	1/4"	1/2"
BEFORE SHARPENING	3 1/2 sec.	10 sec.	25 sec.	30 sec.	32 sec.
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## SHOP TALK

it's tiny enough to fit inside drills, saber saws, and other portable tools using universal motors. Watch this magazine for a report of the first tool to incorporate this remarkable built-in speed changer.

### A new high-speed saber saw

Those people at Weller Electric have pulled off a slick bit of engineering. They've taken the same high-speed vibrator drive used in their finishing sander and applied it to a new type of superfast saber saw, due to appear shortly. The blade makes 7,200 cutting strokes a minute, but travels only 3/16". The idea: The fast, short strokes cut quickly and cleanly without tearing and bucking. Another bit of good news is the price: \$22.95. We'll be putting one through its paces soon.

### That nut-and-bolt mystery: It still haunts us

Remember that trick bolt with the nut in the middle? After the answer appeared (July), a couple of readers chided us for describing the bolt as not appearing to have any joint when in fact it did. We honestly didn't intend to confuse anybody. We simply said: "Close examination *reveals* no joint." And truthfully it doesn't—as several frustrated editors quickly found out.

We also received many fine suggestions from readers on alternate ways of solving the puzzle. The one that cropped up most frequently was heating the nut and chilling the bolt to permit the two to slip together. We checked this with our technical department. Unfortunately the report is that there wouldn't be sufficient expansion and contraction to make it work. But it's a nice try.

### Good to know

Spray-on lubricant for taking the stick out of drawers, hinges, and the like comes in a pushbutton can for 89 cents. It's called Elmer's Slide-All.



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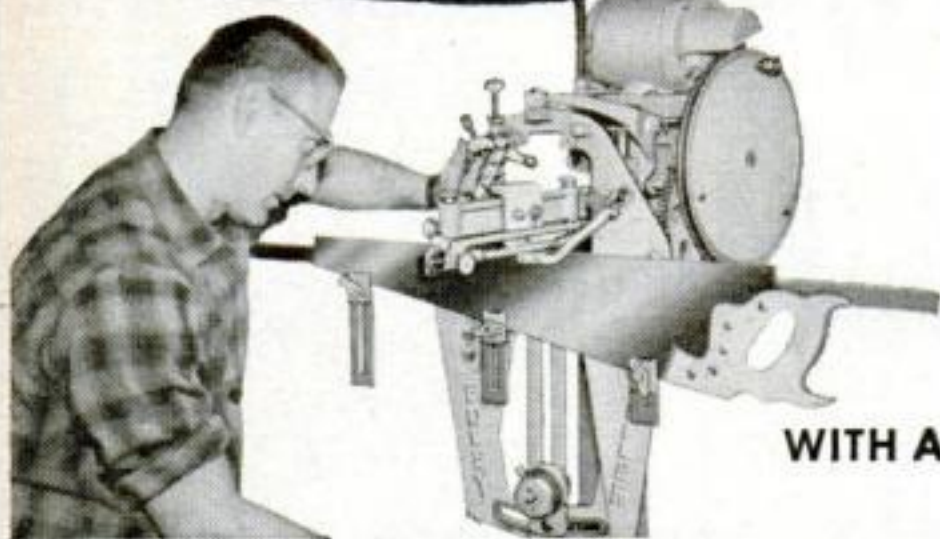
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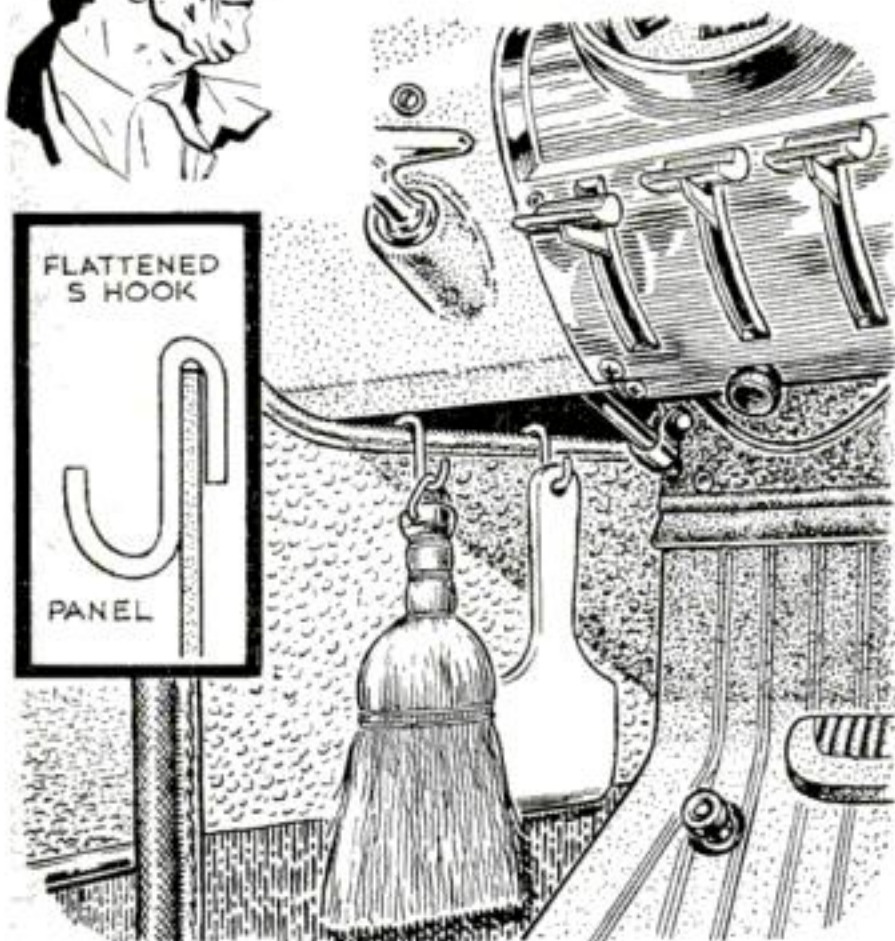
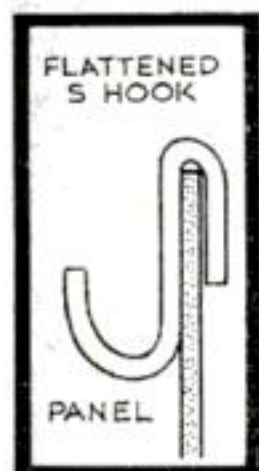
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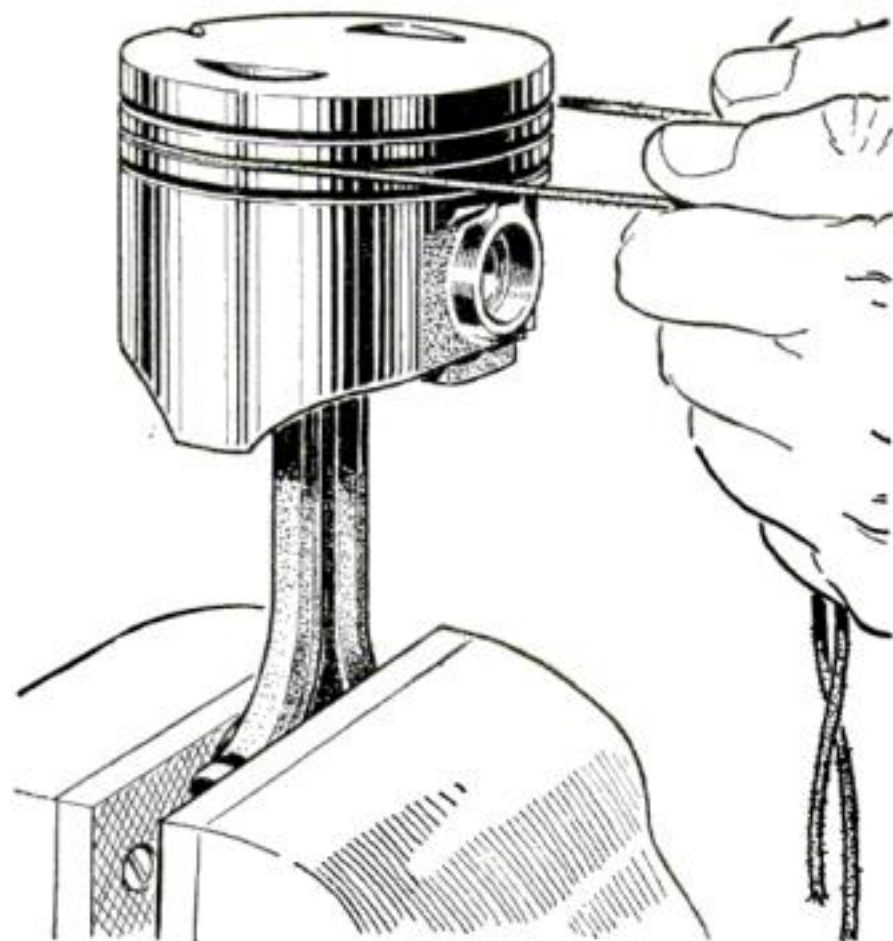




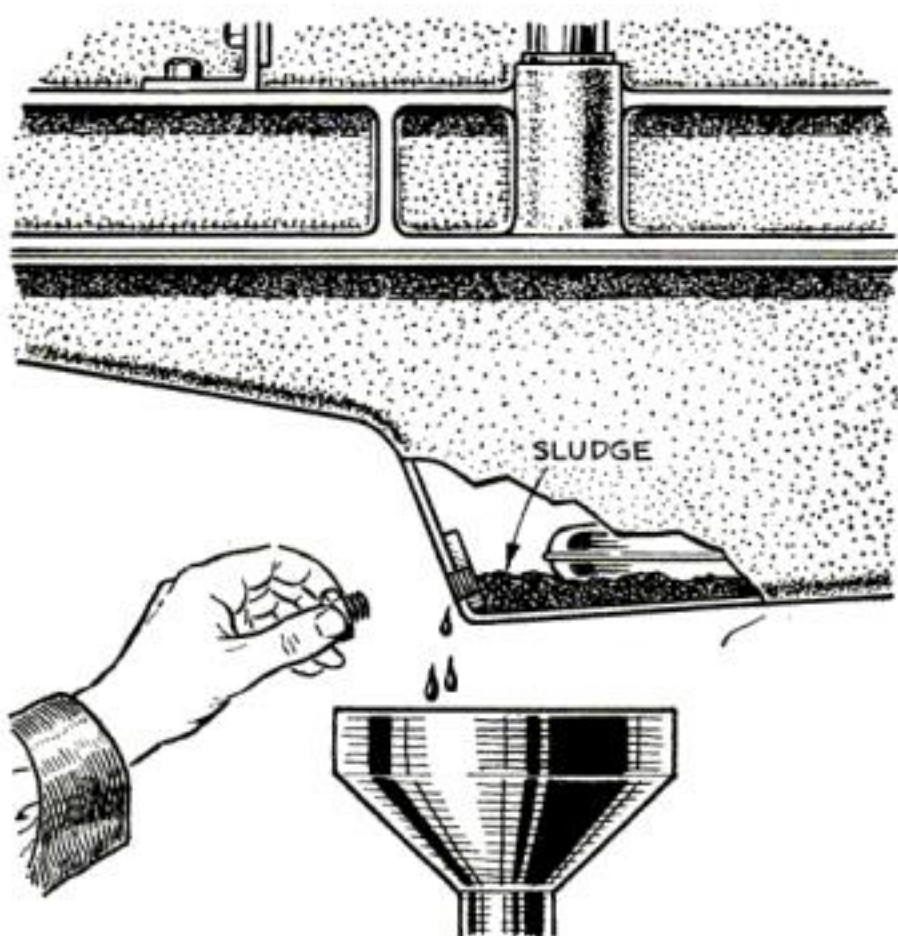
# Hints from the Model Garage



Keep whisk broom and ice scraper handy but neatly out of sight by hanging them from steel S hooks. Flatten one of the loops on each hook so that it can be forced down behind the top edge of the driver's-side kickpad under the dashboard.



Twine easily cleans out the grooves in pistons when you're installing new rings. Dip the twine in oil and coat it with fine sand or abrasive dust. Work it back and forth to scrape out carbon deposits. When you're done, wash the pistons thoroughly.

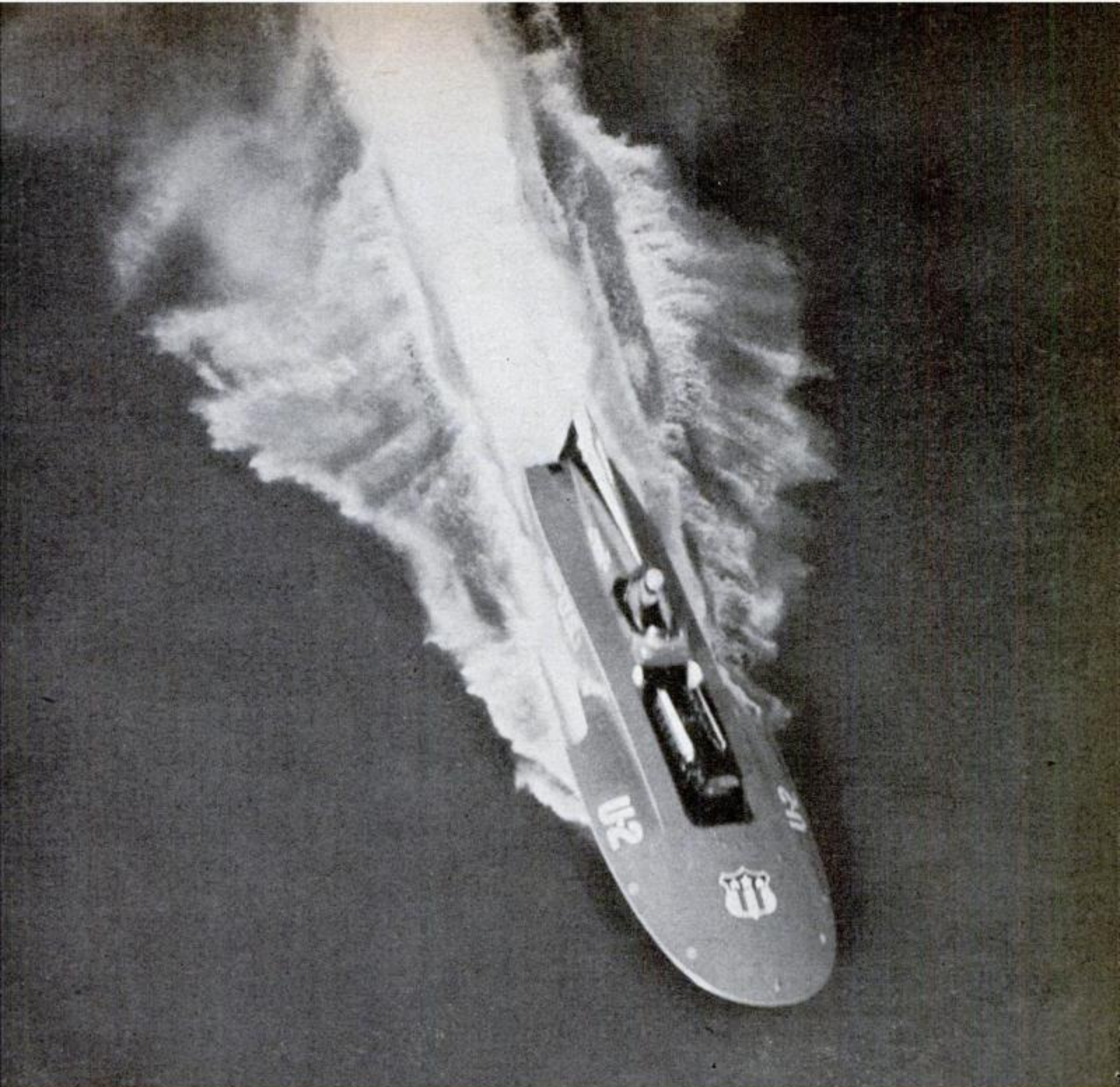


Changing your oil? Have it drained only after a hard drive (at least 10 miles). When oil is hot and thin, sludge won't settle and harden. If you leave your car at a service station for a change later in the day, the cold sludge won't flow out.



When adjusting the carb on an alternator-equipped car, turn on the lights. If you don't, idle speed will be too low at night when lights are used. Alternators have a higher output at idle than generators, but they also drain more engine power.





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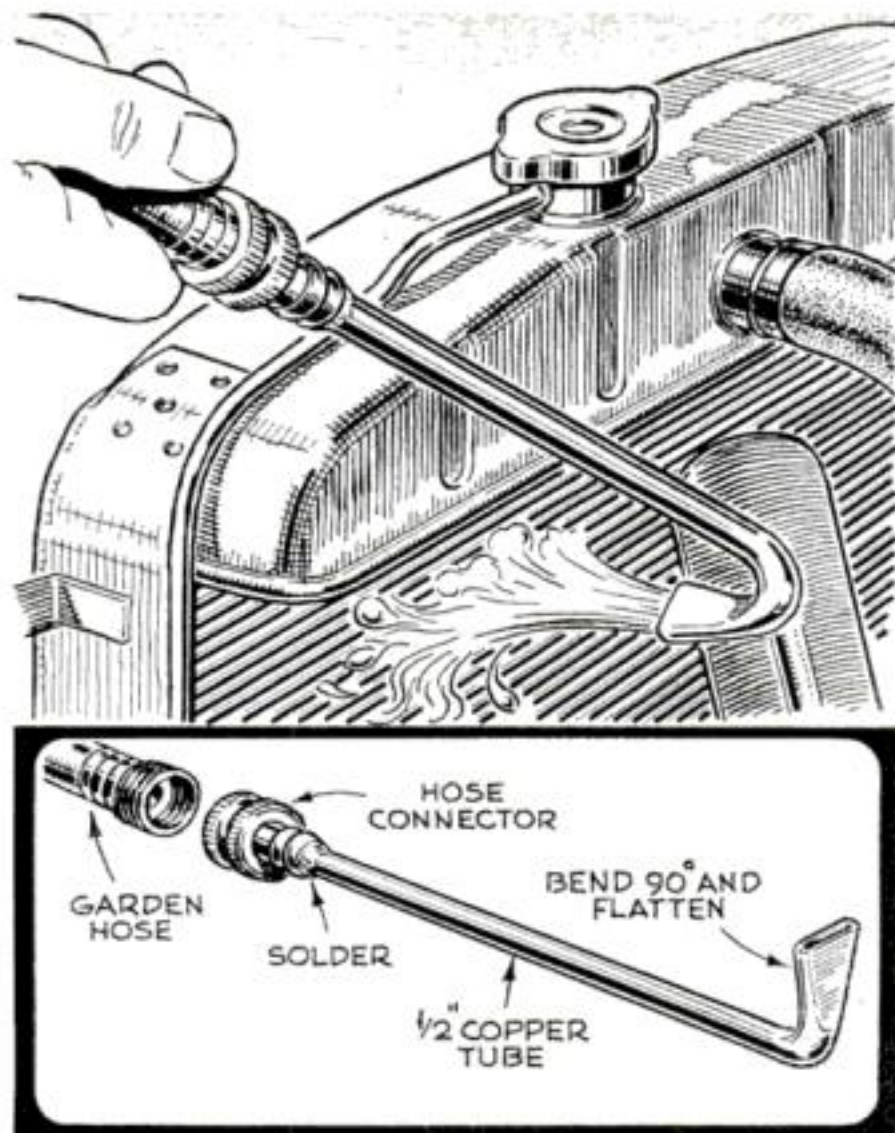
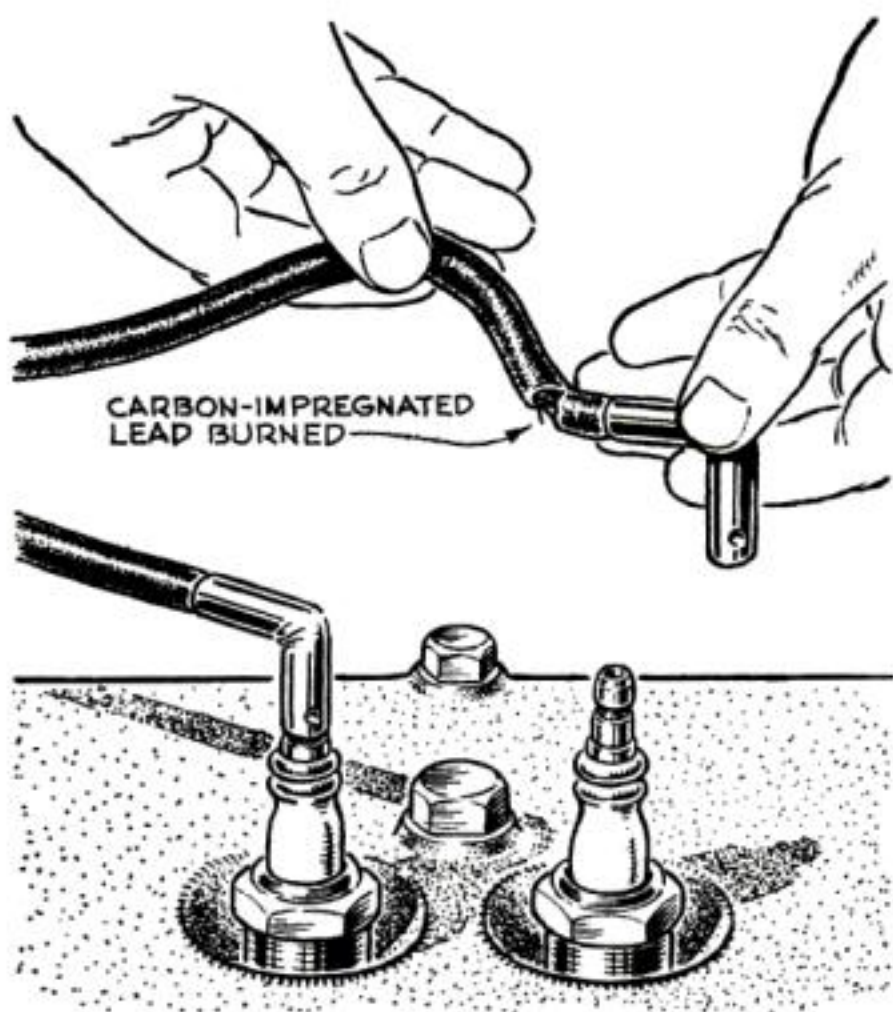
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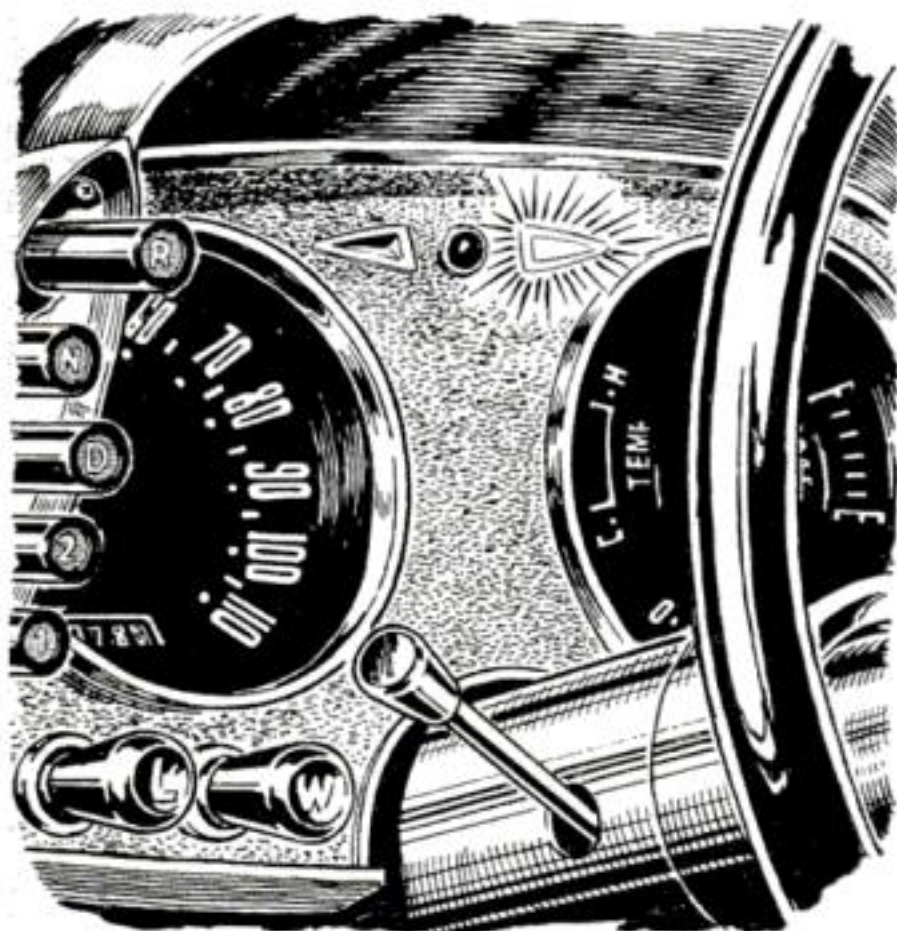


## More Hints from the Model Garage

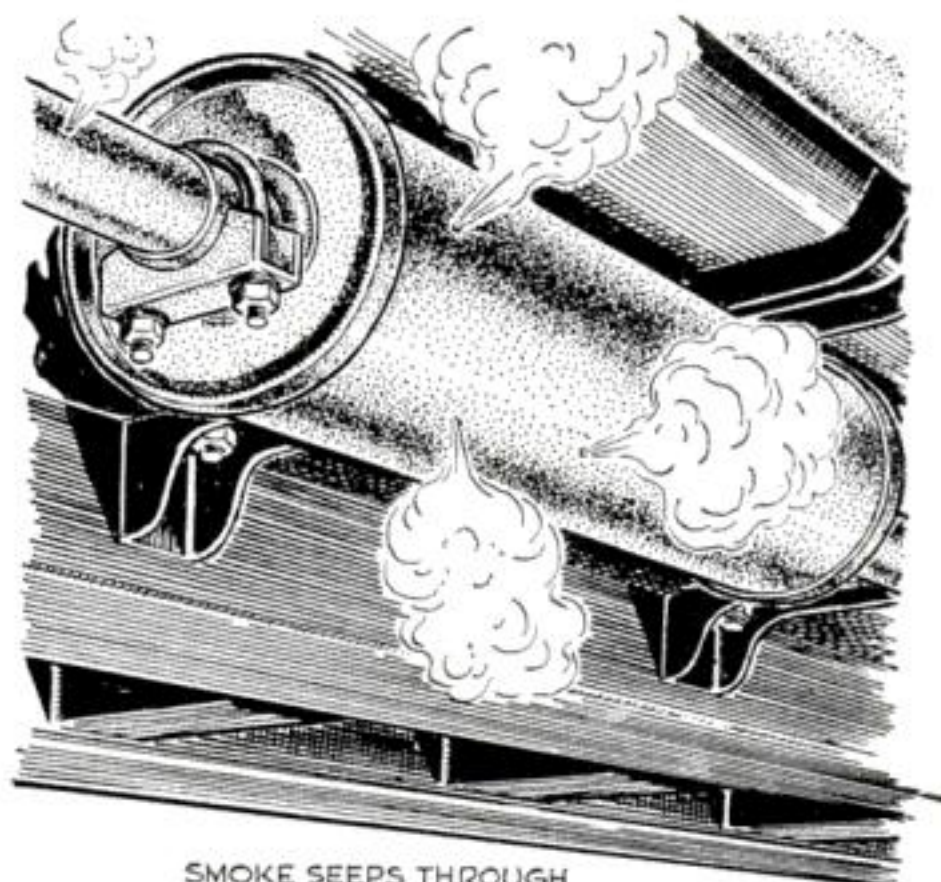


A persistent engine miss—one not due to bad points or plug—often can be remedied by replacing high-tension leads. Leads containing carbon-impregnated string instead of wire may appear sound even though internal arcing has broken the connection.

Cleaning bugs from the radiator core is easy with this homemade spray gun. Pinch a foot-long section of 1/2" copper tubing nearly shut at one end. Carefully bend the tip 90 degrees. Solder the other end to a connector from a garden hose.



The clicking of the turn indicator is a good test of the condition of your car battery. If, with the engine shut off, the clicks are slower than usual or more than a second apart, it's a good bet your battery is more than half discharged and needs attention.



SMOKE SEEPS THROUGH PINHOLES OR LOOSE CONNECTIONS

-Patrick-

Locate dangerous exhaust leaks with smoke signals. Have a friend generate clouds of smoke by pouring kerosene or upper-cylinder oil into the carburetor with the engine idling fast. The smoke will seep through and reveal even the tiniest pinholes.



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# GUS CHECKS OUT

By Martin Bunn

**J**ERRY CORCORAN wants me at State Police headquarters," said Gus, hanging up the phone. "You carry on, Stan."

"Sure, Gus. What's with the cops?"

"They picked up a suspect on that burglary last night. Want me to check his car. I won't be long."

Gus had hardly left when brakes squeaked gently outside and a 1959 V-8 hardtop rolled into the Model Garage.

"Oh, no!" gasped Stan soundlessly.

"Is that you, Stanley?" fluttered the brightly dressed, pretty matron who got out. "Is Gus Wilson in, or are you going to fix my car all by yourself?"

"Depends what it needs, Mrs. Allen."

"Well, it runs fine, only it doesn't start. Of course, I might have expected that after my sister Carrie had her car at my house all week."

"Yes, ma'am," said Stan dubiously. "How did you start it to get here?"

"The same thing happened with Carrie's car last night, and a man just pushed it. So when mine made this buzz, instead of going chug-a-chug, I asked a neighbor to push me. And it started!"

Stan got in, drove the car on the lift, and cut the engine. When he turned the key to start, there was a tell-tale whine, but the engine didn't crank.

"There!" cried Daisy Allen. "That's what Carrie's car did. She kept it next to mine in our garage, and they're the same make, so I guess it was catching. It probably runs in the family."

Stan made a strangled sound and disappeared under the raised car. Dropping the splash pan, he removed the starter and hooked it up at the test bench. The motor whirled and the pinion spun, but failed to slide out to mesh with the flywheel ring gear. Stan phoned the local agency for the car.

"Starter clutch assembly?" replied the stock clerk. "We don't keep 'em."

Stan turned to Mrs. Allen. "Sorry, but



*"Drove it here myself after we picked Dougal up," said Corcoran. "Never hit 45, but it ran okay."*

we have to order parts from the city. They should get here tomorrow."

Daisy Allen pouted. "But I need the car! Carrie's already on her way home—that nice young man at the agency fixed her car right away."

"Ben Driscoll?" asked Stan thoughtfully. "Well, you leave the car, Mrs. Allen. If I can't fix it in an hour, I'll take it over to him myself."

"**Captain Bullock** calls it open and shut," Lieutenant Jerry Corcoran told Gus at headquarters. "Early this morning the Hayworths' caretaker found a window jimmied and the room inside ransacked. Hayworth,



# AN ALIBI



who was out of town, says that \$2,000 is missing."

"Where'd you find this suspect?"

Jerry Corcoran rubbed his chin. "That's what bothers me. Asleep in his car half a mile away. But we matched tread marks in the Hayworth drive to his tires. And Tim Dougal's an ex-con, with a record of rural burglaries. A neighbor driving by at nine o'clock heard a casement window bang

in the wind. He looked just in time to see a tall man run off the porch. Dougal's tall."

"Where does his car come in?"

Jerry opened the door. Another trooper led in a man whose six-foot height was shrunk by a slight stoop.

"Sit down, Tim," said Corcoran briskly. "Tell it all again."

The middle-aged suspect folded into a chair. "What for?" he asked bitterly. "I

CONTINUED

41



learned printing last time I went up. Gone straight ever since—but first time I'm near any trouble, I get nailed."

"You came here to get a job?"

"Owner of the *Thorburg Sentinel* told me to be there at nine, after the paper is put to bed. My old car ran all right in town, but on the way it kept missing and slowed me down. I stopped at a gas station about eight. They put in new points while I phoned Thorburg."

"The car ran okay after that?"

"At first. Two women flagged me from a closed gas station in West Milltown. They'd stopped their engine before seeing there was nobody around. The starter didn't work. I pushed 'em to get the engine running. No," Dougal added as Corcoran began to ask a question. "I didn't get any name or license. The car was from out of state."

"And what time was that?"

"'Bout nine. That's when my crate began to miss again. That's why I stopped in Shrewsbury about quarter to ten. Later I drove into that Hayworth place by mistake, but like I told you, I drove right out again."

Corcoran signaled the trooper, who led Dougal away.

"I went personally to both those gas stations," said Jerry. "You know what was wrong both times?"

"You tell me," said Gus.

"Both times the wire was off the number two plug. Captain figures Dougal yanked it off himself, drove to the first station, then raced to the Hayworth place. After taking the money and stashing it, he drove back the way he'd come, pulled the cable off again, and limped into that Shrewsbury station to make it look as if he'd only got that far."

"But what bothers me is that Dougal couldn't know that neighbor would spot the thief and set the time, and that he

stuck around. I can't help wondering—"

"Whether a cable could pull off by itself," finished Gus. "Let's go see."

The car was a paint-faded 1953 of a popular make. "Drove it here myself after we picked Dougal up," said Corcoran. "On that twisty road from Hayworth's I never hit 45, but it ran okay."

Gus gave the number two cable a tentative pull. It held. He yanked it off, pushed the end through to inspect the terminal clip, and replaced it. "I can't see this coming off by itself. Even

the cap's a tight fit. I better drive the car."

The engine idled smoothly. Gus wheeled onto a four-lane parkway, pushed the car to 30, 40, and 50 miles an hour without a skip. Then he floored the gas for a spurt around a midget sedan. The engine began to gallop in a one-cylinder miss. When Gus pulled off the road, it stalled.

He flung the hood up. Number two cable was off. The plug terminal was clean, the porcelain free of any oil film. Gus replaced the

cable and headed back to headquarters. Half a mile away, he stepped on the gas. At 58 miles per hour, one cylinder again cut out. "Doggone," sighed Gus.

"Ben?" asked Stan on the phone. "You still shop foreman, or did they find out you can't even spot a flat tire?"

"When Gus Wilson fires you," retorted Driscoll, "come around. I've got a job for you—on the wash rack."

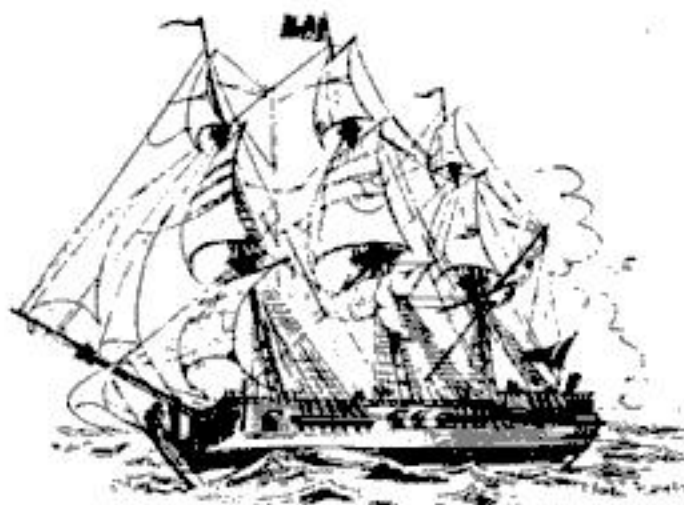
"Yeah. Listen, Ben, I may have to send you a customer. Starter won't engage. You fixed the same grief for her sister this morning."

"Starter just spins, hey? Sure."

"Your parts shop hasn't got a new clutch, and she wants it today."

There was a brief silence. "Never mind. Can do. Send it over."

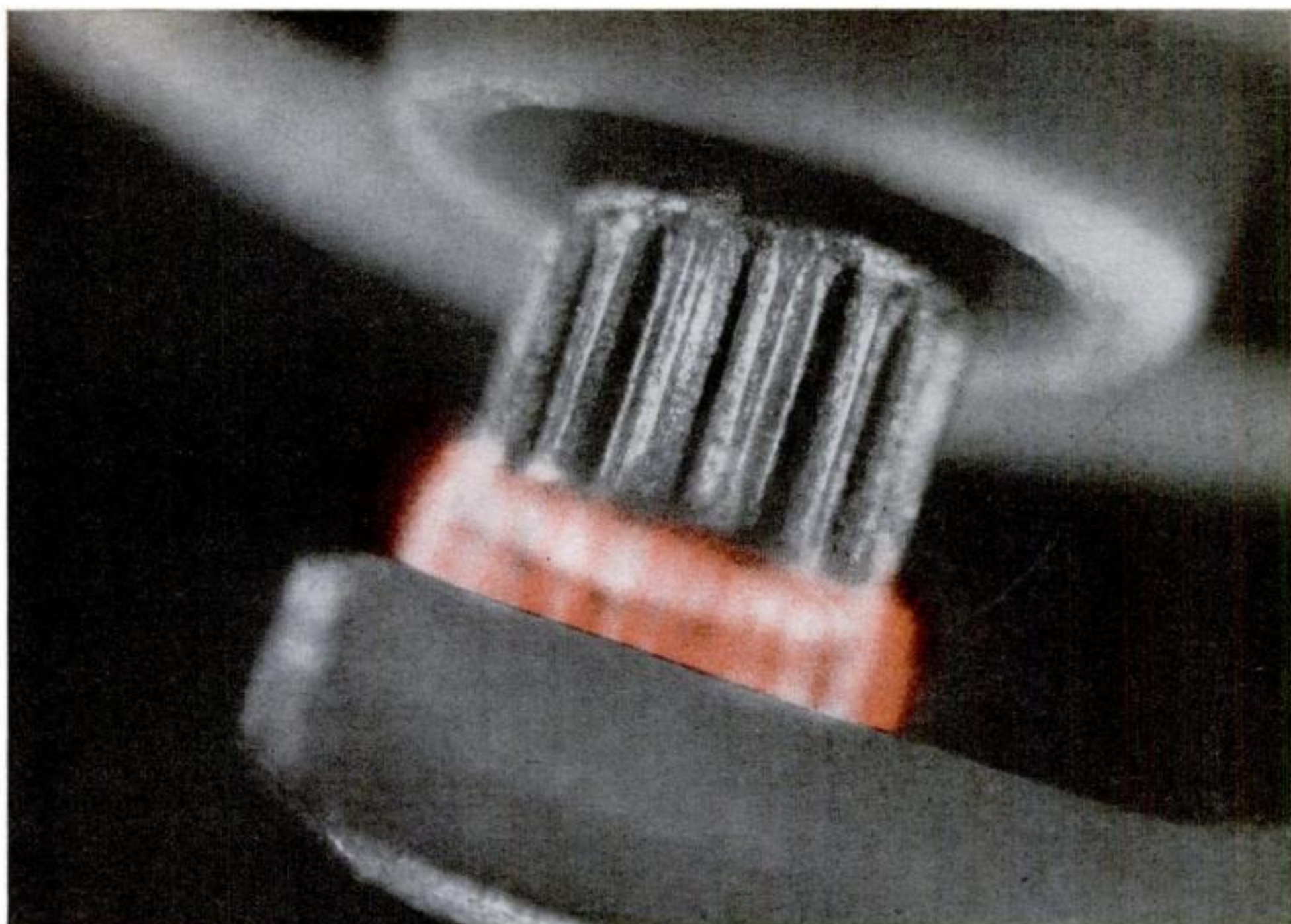
### Where'd it come from?



### "Three sheets to the wind"

The picturesque expression to describe a state of intoxication is nautical. A full-rigged ship would have three foresails set. In changing tack ("coming about"), the sheets or lines would naturally be loosened. As the ship came up into the wind it would lurch—not unlike a drunken sailor.





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"Not unless I have to. But thanks."

Back at the bench, Stan removed the clutch. The solenoid winding checked. Why didn't it have enough punch to snap the pinion out—and how did Driscoll plan to fix it without parts?

Slipping off the clutch, Stan fingered the spring behind it. This helped the solenoid at the start of its stroke, when it was weakest. The spring felt weak. Maybe it didn't help enough . . .

Seizing both ends of the spring with pliers, Stan stretched it a half-inch. He

"Hold it," growled Bullock. "He could've put a bum plug in to rig this story of his. I don't buy it."

"How about those women he helped?" asked Corcoran. "We should check—"

"Check an unidentified, out-of-state car?" sneered Bullock. "You kidding?"

Jerry flushed. "Thanks for a darned good try, Gus."

"Good work," approved Gus when Stan described the starter repair. "I fixed a few of those the same way. The assist spring is a shade weak in that model—sort of runs in the family."

"That's what Mrs. Allen said. Her sister has the same car and got stuck near West Milltown last night."

"Her sister stopped here for gas once," interrupted Gus. "She has Southern plates. How did they get the car going?"

"Fellow in a jalopy pushed them."

Gus grabbed the phone. "Can't have been two cars stuck in the same place for the same reason in one night. I'm giving Jerry a tough assignment—to get the facts from Daisy Allen."



reassembled the clutch. On test, it threw the pinion out with a snap. Back in the car, it cranked vigorously.

Bucking to a stop at headquarters, Gus found Jerry Corcoran waiting beside burly, red-faced Captain Bullock.

"Wasted your time, hey, Gus?" he roared. "Dougal's guilty as sin."

"Don't know about that," said Gus, flinging up the hood. "But this cable popped off by itself on me twice. And I think I know why."

Turning the idle adjustment up to prevent the engine from stalling, Gus got an oil can from his car. With the cable still off, he dripped oil slowly around the top of the plug.

"See those bubbles? There's a leak around the electrode. When the cylinder is firing, at speeds over 55, it builds up enough pressure inside that cap to blow it off."

"Then Dougal wasn't—" began Jerry.

Corcoran's car braked to a stop at the Model Garage about closing time.

"Don't know whether to thank you or book you for disrupting police procedure, Gus," he said wryly. "That Allen woman . . ."

Gus and Stan grinned at each other.

"Captain Bullock insisted on going along to question her. I don't think he'll ever be the same. But we learned enough to have the Maryland police stop her sister and take a statement. Dougal did help them. So we overhauled the caretaker's story."

"He's not only as tall as Dougal, but finally broke down and confessed. We'll release Dougal and put in a good word for him at Thorburg."

"Guess you wrapped it up," said Gus. "Leaves only one thing missing."

"What's that?"

Gus handed Jerry a small carton. "Number two cylinder in Dougal's car. Have him put in this new plug—compliments of the Model Garage."



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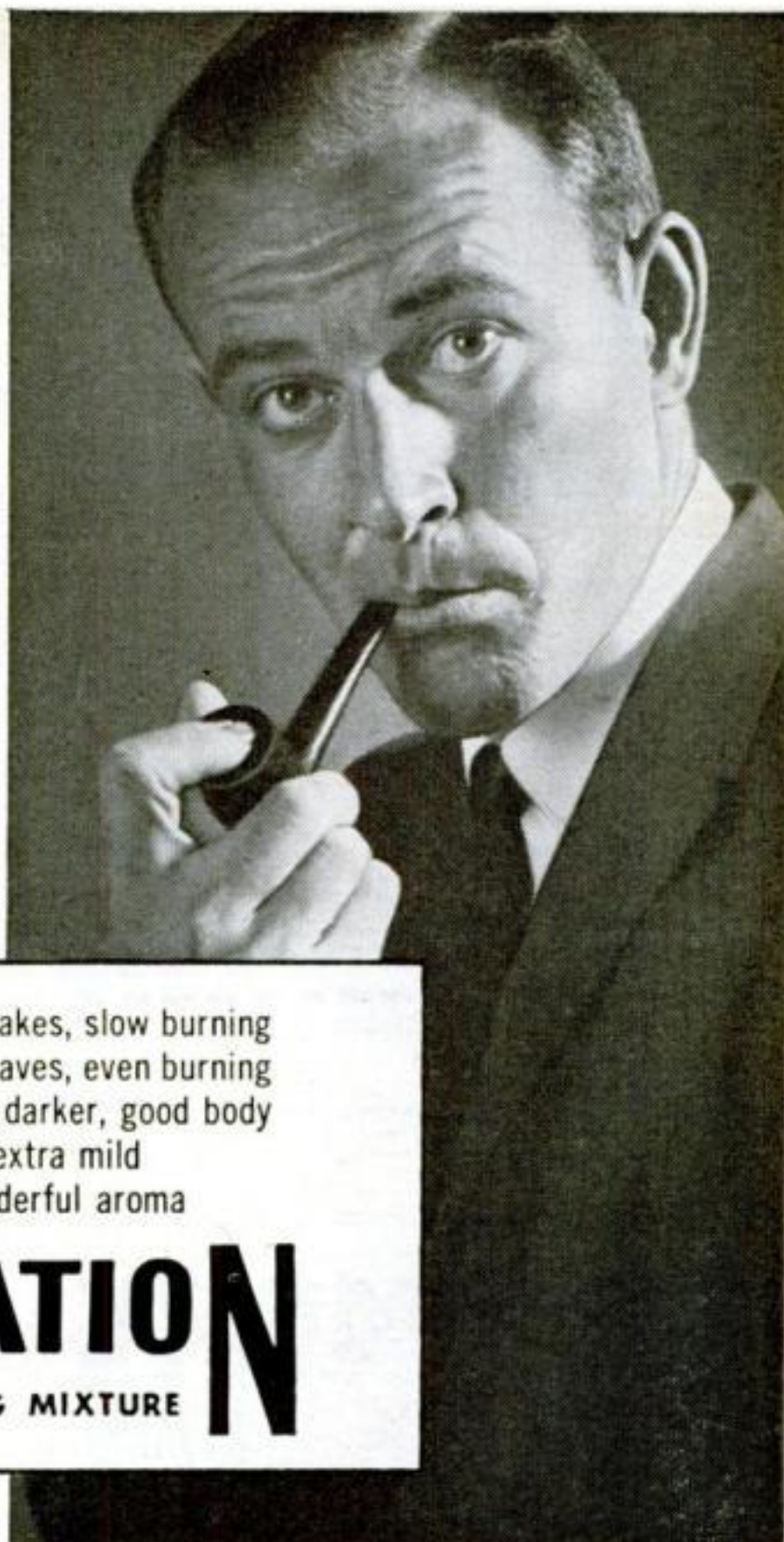
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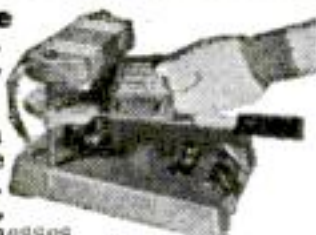



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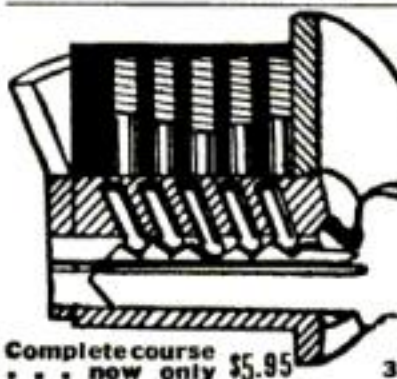


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# Detroit report

By Devon Francis

## Dodge: An advance peek at Chrysler Corp. cars

Last month, Chrysler Corp.'s Dodge Division handed around the vital statistics (but no pictures) on its 1963 automobiles. The package amounted to a bulky disclosure of what Chrysler plans for *all* its new cars. That's the way things are at Chrysler—and, by the way, at the Ford Motor Co., too. What pops up in the Dodge is likely to appear in the Plymouth. What's the Galaxie's is often the Monterey's. This rule does not necessarily hold good with General Motors products.

Chrysler will publicly announce its '63 Chryslers, Plymouths, and various brand-name variations thereof this month.

What's new with Chrysler? A host of small things, but nothing of real goggling importance.

- Lots in styling. The company has torn up most of its sheet metal, as the saying goes, on most of its cars and socked out new panels. Only the doors remain from 1962. That bobtailed look—referred to vulgarly by some as the "duck butt"—has disappeared from many of the company's automobiles. Now they resemble all the rest of Detroit's standard products.

- A "new" engine of 383 cubic inches—new in the sense that it has not been produced in any volume before—for the 1963 Dodge and Plymouth. The bigger engine will not be available in the Dodge Dart, and we will come to *that* confusing situation in a moment.

- Improved carburetors for a more precise fuel-air mixture under all driving conditions.

- Alternators that are better sealed against dirt.

- Exhaust pipes coated with aluminum for longer life.

- Starting motors with more muscle

for easier fire-ups during cold weather.

- Full-flow oil filters made standard.

- Manual transmissions with lower clutch-pedal pressures and shorter pedal travel.

- Stronger door latches that will no longer need periodic adjustment.

- Windshield wipers that will resist the temptation to pull away from the glass at high road speeds.

- Most of the clips holding the trim molding to be of rustproof nylon.

- Transistor radios as options.

- Two-ply tires factory-installed on Dodges and Darts, except for station wagons. For them: four-plys.

- Finally, like all the new U. S. cars, Chrysler's will flash amber lights for turns, and engines will feed back unburned crankcase gases into the cylinders.

## Adieu to the Lancer

Hold your hat, now, because we are about to try to explain some of the cockeyed things that have been happening to Dodge trade names and car sizes these last three years. They add up to Confusion Incorporated.

The Chrysler Corp. brought out its first "compact" car—remember?—in the fall of 1959 as a 1960 model. That was the Plymouth Valiant. A year later Dodge introduced its Lancer, which was essentially a Valiant by another name. This was the way the Dodge Division sedans lined up for 1961:

The big Dodge, called the Polara, was 212.5 inches long. Its standard horsepower was 265.

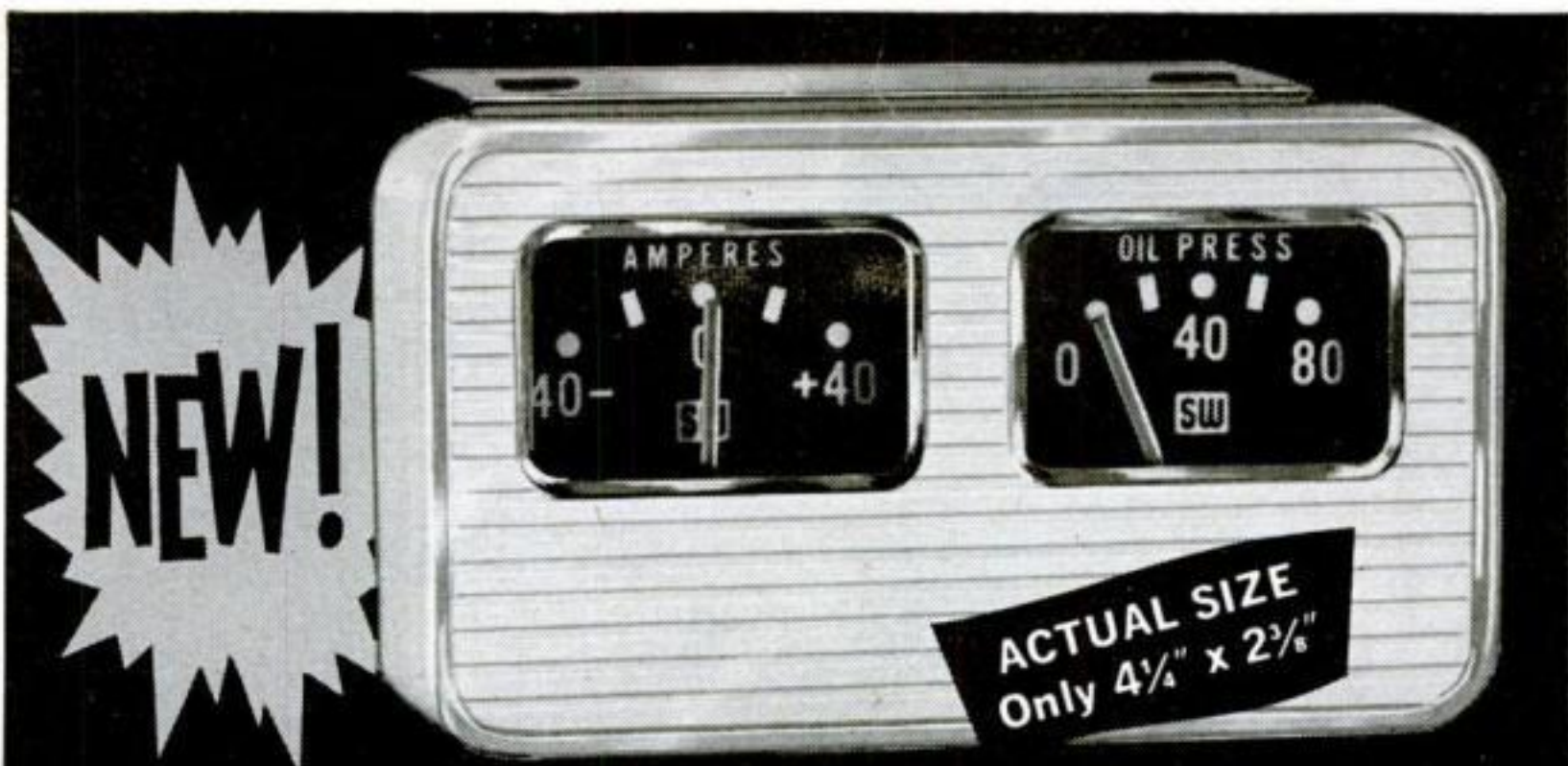
Dodge also had a biggish car called the Dart, which was essentially a Plymouth. It was the same length as the Plymouth—209.4 inches—and offered a six-cylinder engine of 145 horsepower and a V-8 with 230 horses.

Then there was the little Lancer at 188.8 inches. This one had a standard six-cylinder engine of 101 hp. and an optional six of 145.

Station wagons, of course, were a few inches longer.

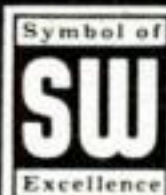
So much for 1961. For 1962 some de-





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## DETROIT REPORT . . . continued

cisions taken in the parent company's carpeted inner councils brought drastic changes:

The Polara shrank to 202 inches overall, with 305 hp., the Dart to the same length, and the Lancer to 184.2 inches. Same engines for the Dart and Lancer.

But bigger cars were returning to popularity. So, last January, Dodge announced a car called the "880." With its 265 hp., the "880" was a thinly disguised Chrysler Newport bearing the Dodge name. Its length: 213.6 inches.

Now comes 1963, and if you are suffering a dizzy spell from trying to follow the ins and outs of Dodge nomenclature and sizes, hear this:

The Polara has grown—to 208.2 inches in length—and has become one of a series of big Dodges. There's the Dodge 330, the Dodge 440, and the Polara, plus a "Polara 500." The differences are marked by chrome, the industry's customary gewgaws, and engine options. Dropped with a thud: the "880."

The 1963 big Dodges, all four of them, are designed, according to the unabashed publicity handouts, to compete with the Chevrolet and Ford Galaxie. (Where does this leave Plymouth?)

There is also the Dodge Dart, "a senior, luxury compact." Where compact-size cars end and bigger cars take over, no one seems to know. The Dart will be 195.9 inches long. (The compact Ford Falcon measures 181.1 inches; the Chevy Corvair, 180; the Plymouth Valiant, 184.2; the Rambler Classic, 190; the Chevy II, 183; and the Ford Fairlane, 197.6.)

The compact Dodge Lancer is dead. The name almost survived as one model in the Dart series—but at the last moment *that* idea was junked.

As this is written, horsepowers have not been announced. The big Dodges come with a 225-inch six-cylinder engine and an optional 318-inch V-8—except for the Polara 500 which carries a 383-incher. The Dart carries engines that for 1962 were rated at 101 and 145 hp.





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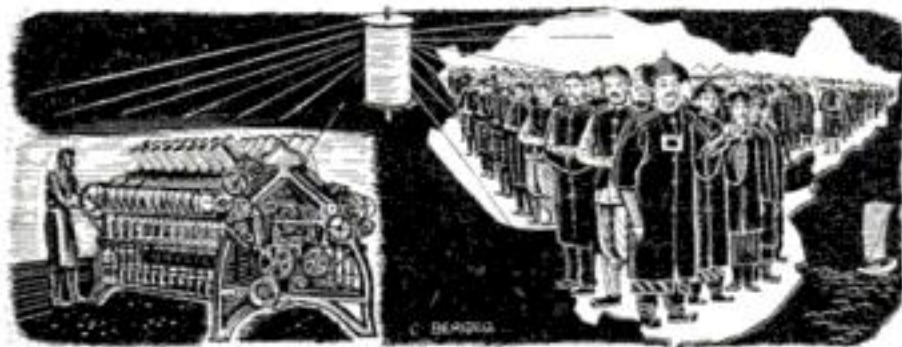
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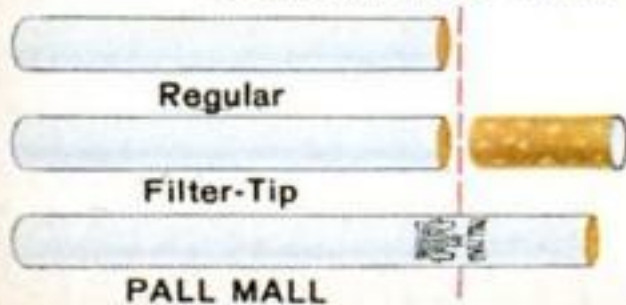


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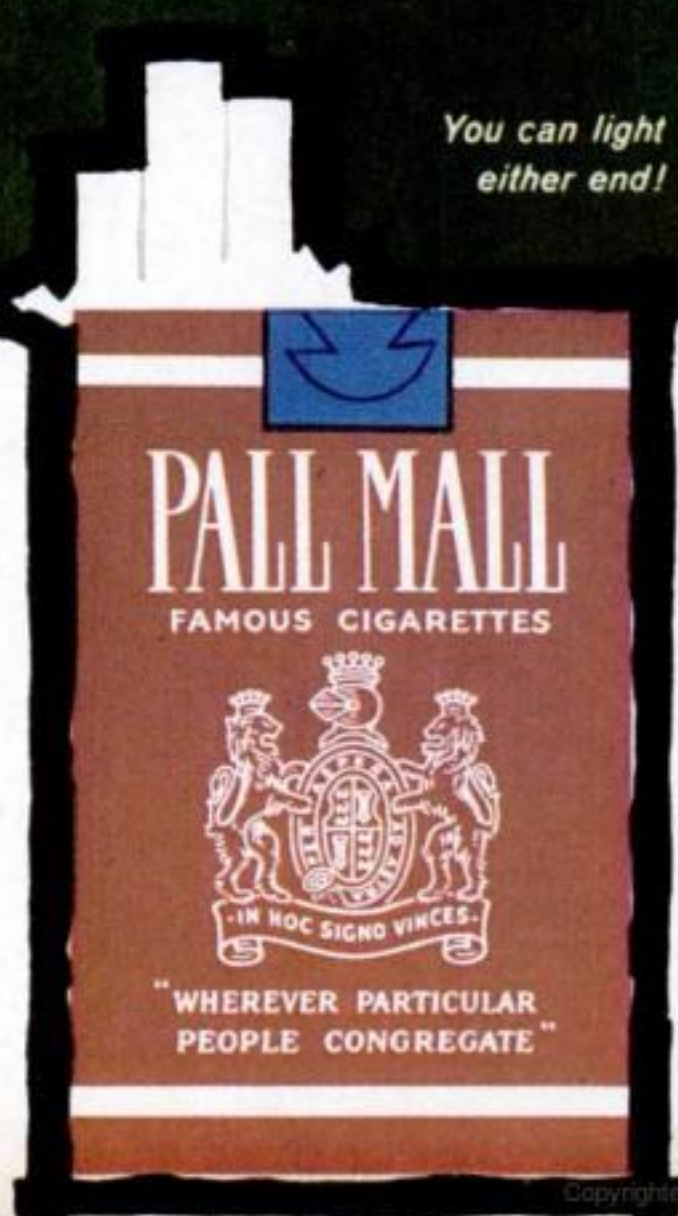
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First of the '63 cars: Ford beefs up the Falcon unitized frame-body to produce a convertible free of the rag-top's customary front-end shake

# Falcon Goes Convertible

By Devon Francis

**H**ANS MATTHIAS is a blunt-spoken man with a tincture of his native German on his tongue. He knows what he wants. He takes no back-talk from his staff.

Last month the Ford Division introduced a Falcon convertible—the latest thing in its compact line of cars—and it bore the stamp of Hans Matthias. It had taken a solid two years to satisfy him—in his capacity as chief engineer of the division's product-engineering office—that the new convertible would be rigid enough to thump over cobblestones without front-end shake.

Despite an extra-heavy frame, most convertibles do shake in front. The vibrations start at the prow and gallop to the stern. To a driver on washboard footing, a convertible feels like spare parts moving in formation. That's because the car has no upper body structure to form a strain-resisting box.

The new Falcon convertible, thanks to Hans Matthias, is practically as solid as a sedan.

When the engineers trotted out a prototype of the

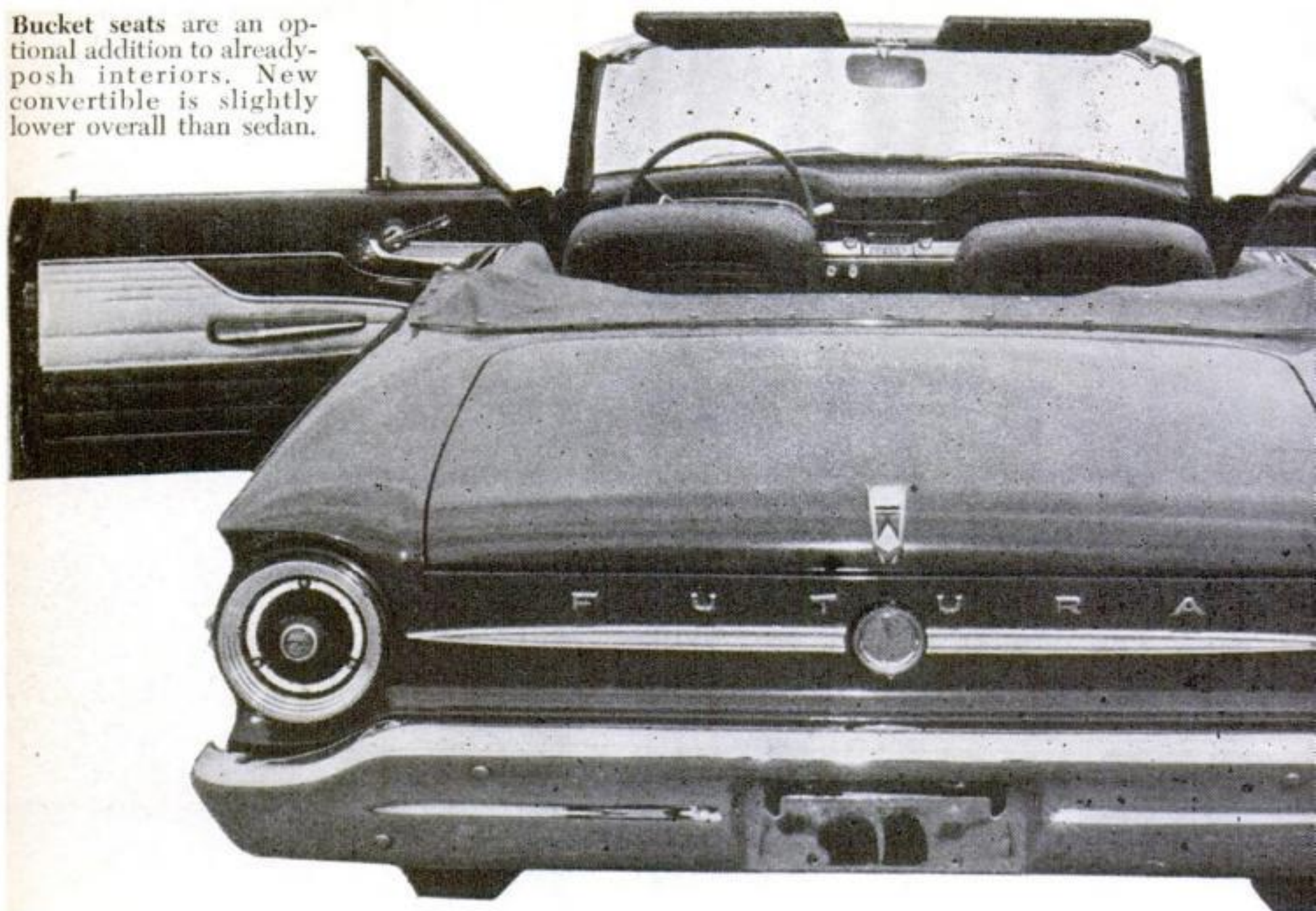
CONTINUED





## With a "hot" factory run-in, engines need no dealer inspection

Bucket seats are an optional addition to already-posh interiors. New convertible is slightly lower overall than sedan.



Falcon rag-top, as convertibles are known in the trade, Matthias was thin-lipped as he crawled from the driver's seat after an initial spin.

"It shakes," he said.

They doubled the strength of the side rails in the unitized frame-body.

"It still shakes," he said.

They welded a box girder across the body under the driver's seat.

Matthias scowled.

They stiffened the body, and the girders projecting from it for the engine mounts, with torque boxes. These act much like wood wedges glued to the corners of a cabinet.

"Okay," said Matthias finally.

At this point the convertible weighed 300 pounds more than the Falcon standard sedan. That's a lot of extra poundage on a little automobile that tots up to less than 2,500 to begin with.

The extra weight is reflected in the

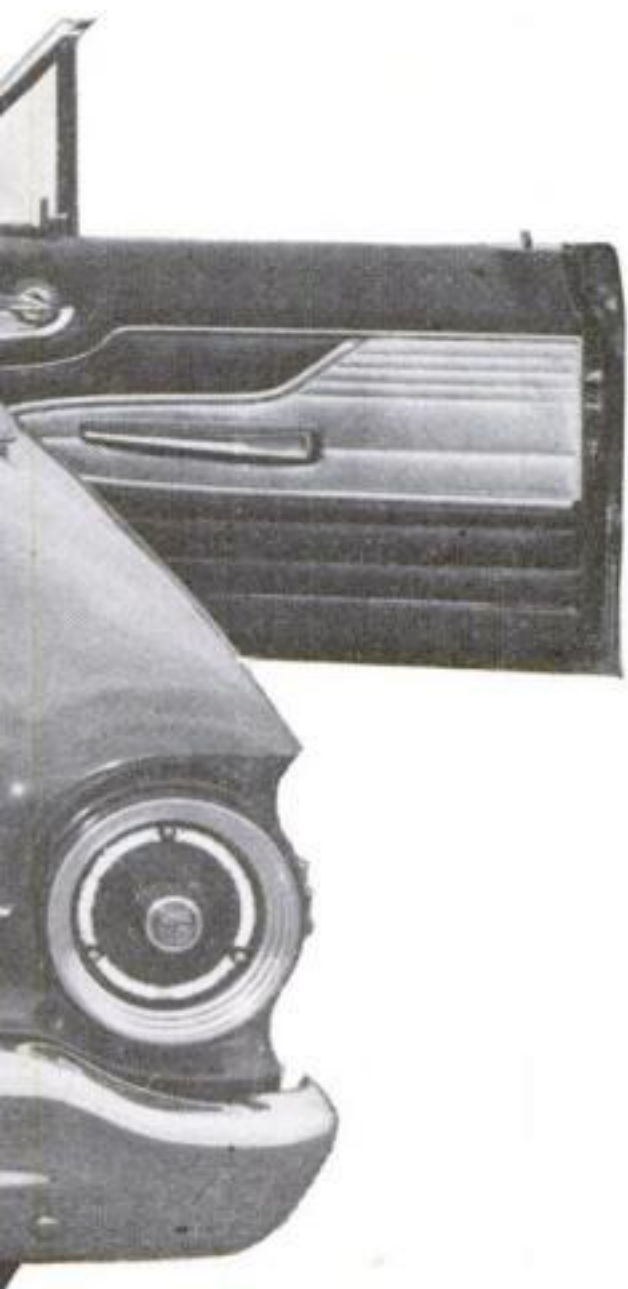
performance. Churning for all it's worth, the bigger of the two Falcon engines, ahead of an automatic transmission, takes 19.6 seconds to reach 60 miles an hour from a standing start. A similarly powered Falcon sedan clips this off in 17.8 seconds.

The new compact Ford in its plush Futura version, put onstage all by itself in advance of other '63 Falcon models, was notable for other reasons besides adding an open car to the line. It telegraphed a series of low-maintenance changes that will appear in sedans and station wagons when they reach the showrooms this month.

● Item: No more dealer inspection after the first 1,000 miles, a part of the auto-industry's medicine show for 10, these uncounted years. At the 1,000-mile mark the dealer used to drain the break-in oil, replace the filter, and put a stethoscope to the block to detect any



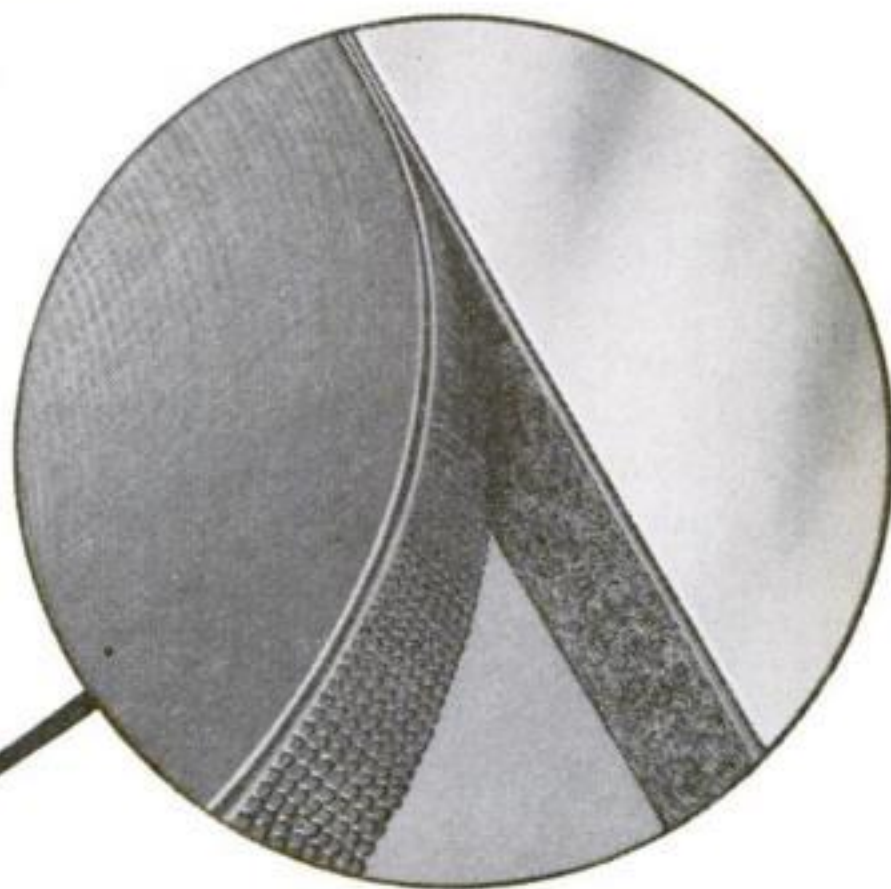
after 1,000 miles



Catch-all bin sits on pedestal between seats in the bucket version. Still another option: floor-mounted, four-speed manual shift.

unwarranted clanking. No more of that. Ford's explanation for this change in owner procedure: Falcon engines are given a factory "hot" run-in—under their own power—for 15 minutes after the heads are dogged down and the accessories hung on. Then the oil is drained, the crankcase refilled, and the filter replaced. That gets rid of the metallic crud that lodges in cylinders and oil pan during drilling and milling operations.

- Item: Chassis lubrication not often-er than each 36,000 miles. For an average driver, this could mean once in



Here's a new wrinkle—minus a wrinkle—on that often exasperating convertible rear window. Falcon's is zippered only at top. A flexible magnet holds other sides.

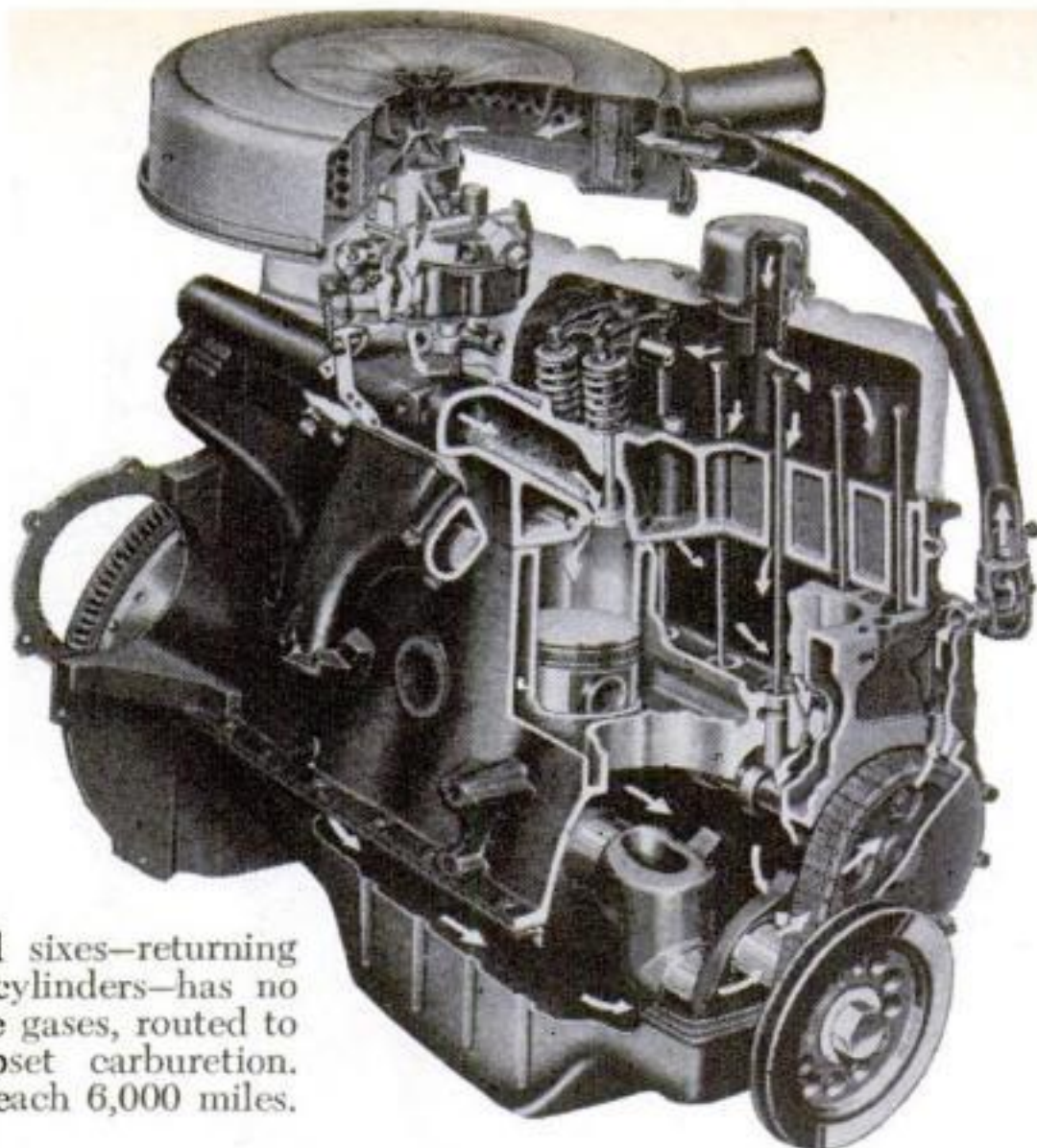






Carbs are water-warmed on both 85- and 101-hp. engines. Hoods open easier with counterbalancing springs.

**Positive crankcase ventilation** on Ford sixes—returning unburned blowby fuel from sump to cylinders—has no valve requiring servicing. That's because gases, routed to air cleaner, not manifold, cannot upset carburetion. Air cleaner must be cleaned, however, each 6,000 miles.



three years. (Exceptions: the Station Bus, formerly the Econoline Bus, and station wagon—each 6,000 miles.)

- Item: 30,000 miles between repackings of the front wheels. Remember that chore each 10,000 miles?

- Item: 30,000 miles between lubings of the universal joints.

- Item: Brakes that adjust themselves to accommodate lining wear.

- Item: Hydraulic valve lifters, eliminating the need to take up lash every so often.

The Falcon already incorporated other low-maintenance items borrowed liberally, like those listed above, from its big brothers in the Ford family of cars. These covered a coolant that permits sealing up the radiator for two years, and a fuel filter and an air-cleaner element each good for 30,000 miles. (But don't forget that the air cleaner has to be *cleaned* each 6,000 miles.) The Falcon already had, too, a 6,000-mile interval between oil and oil-filter changes.

Like all of Detroit's '63 cars, the new Falcon has a positive crankcase ventilation system, drawing the blowby crankcase fumes into the intake system for reburning, to reduce air pollution. But

Ford's system is different. (See drawing.)

And, like all of Detroit's '63 cars, the Falcon has the new amber-colored front turn-signal lights.

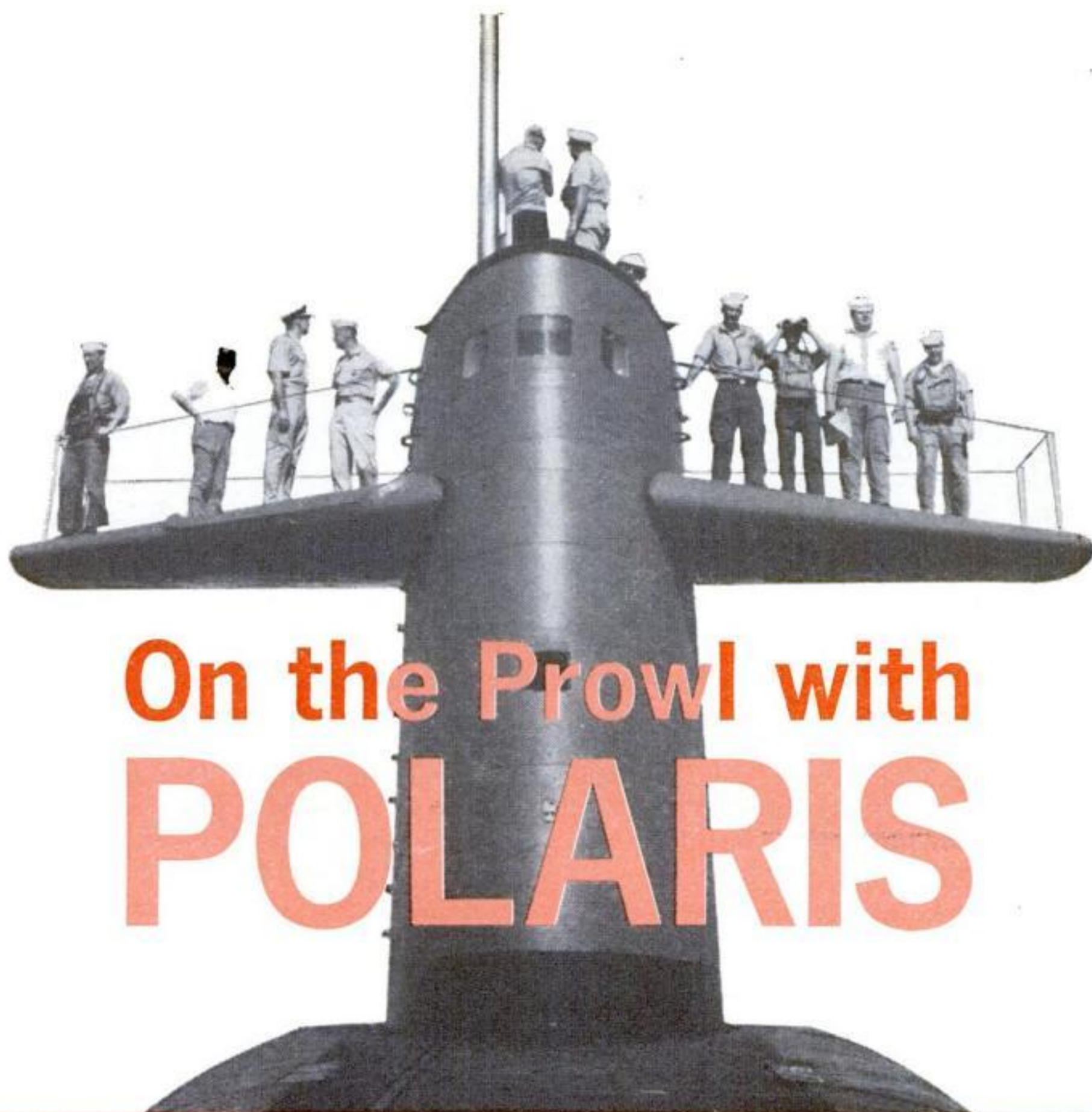
**Tops popularity poll.** It would be pleasant to report that the Falcon is something new in convertibles. It isn't. The Falcon began, in the midst of Detroit's hysteria over compact cars, as a smaller-size vehicle as thoroughly conventional as the plot of a TV Western. It remains that. Even the styling changes between '62 and '63 are almost too subtle for detection.

(The Falcon's popularity hasn't changed, either. It's still the biggest seller among the compacts.)

Only the razzmatazz—the bucket seats, the splashy chrome outside, the flashy trim inside—has been added, as indeed it has been grafted onto all the cars that were born as simple little boxes on four wheels three years ago.

With it, prices have spiraled. The original Falcon carried a factory-suggested retail tag of \$1,912. For the '62 model year, now ending, Falcon's plushy Futura models came at \$2,232. The new convertible will come at substantially more than that. ■ ■





# On the Prowl with POLARIS

PS PHOTOS BY W. W. MORRIS

A PS reporter gives you a first-hand account of an undersea cruise in an atomic-powered, missile-firing sub

**By Frank Harvey**

**T**HE nuclear-powered Polaris-firing submarine Thomas A. Edison slipped through the bright-blue water off Cape Canaveral like a monstrous torpedo. Displacing 6,900 tons, 410 feet long, costing close to \$150,000,000 (including her 16 missiles), the Edison was packaged with the precision of an enormous watch. I stood high on her streamlined sliver of a bridge beside her skipper, Commander Walter



*That's Cmdr. Walter Dedrick, captain of the Thomas A. Edison, welcoming me aboard. He runs a taut and happy ship.*

CONTINUED

59



## A Polaris can be loosed off minutes after an order is received



Dedrick, a stocky man with a fighter's jaw and a twinkle in his eye. We watched the Gulf Stream water mound smoothly over her big bullet nose like shining glass, then explode into foam as it swept aft to the tall black rudder, which looked exactly like the tail of a ditched airliner.

"Captain," I said, "maybe I shouldn't ask this one. But can she hit?"

"Fifteen of the last 16 test Polaris fired have been on target."

"What was the target?" I said, grinning to take the heat out of the remark, "the South Atlantic?"

Dedrick's eyes lost their humor. "We are roughly a thousand miles from New

York," he said. "If New York happened to be an enemy city, and I was ordered to fire at it—I could put one in the Yankee Stadium."

Six Polaris-firing nuclear subs are now on station out of Holy Loch, Scotland. Each ship has a Blue crew and a Gold crew. When one comes off duty and flies home for rest and retraining, the other goes out. Each ship carries 16 missiles with a range of more than 1,200 miles. The power of their warheads is classified. On defensive patrol the submarines run submerged for 60 days. They are moving at good speed—since fuel is no problem.

**"Flying" a sub.** To reach the main control room of the Thomas Edison you descend a long vertical ladder inside a tight tube. When POPULAR SCIENCE photographer Bill Morris and I arrived in the room, the sub was loafing along at 15 knots. Two sailors sat behind airplane-type yokes, similar to those used to fly a big jet transport. They were making the same kind of control motions: pulling back slightly, easing forward, watching dials on a control panel. I began to realize that these nuclear subs really do "fly under water." They can bank and turn so steeply that the crew must hang onto something solid or go sliding off helplessly on the steeply canted decks.

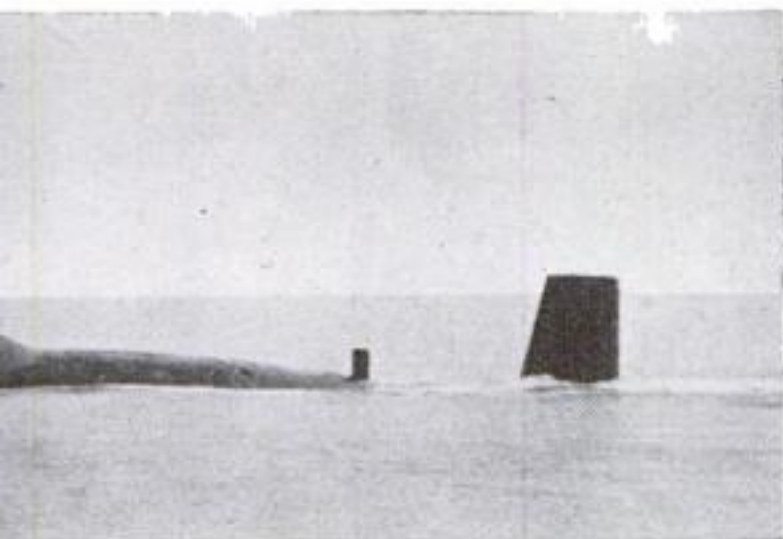
**Lighting?** During daylight hours, the control room is lit with white lights, since a sudden surfacing then would not entail the need for night vision on



*There are enough switches, lights, and circuit breakers in the main control room to pop your eyes. But to a visitor the ship seems almost to run herself.*



## from the President



*On the surface, the Edison loafs through the water like a clean steel whale. Below, she can cut capers like a fighter plane.*

*And these planesmen are the pilots in aquabatic maneuvers. But except when the big sub is horsed around, you can barely see the control movements as they follow the dial needles.*



the periscope. During darkness, however, the control room and other key areas of the ship are lit with red lights (and certain officers about to go on duty wear red goggles while dining in the wardroom) lest persons there be called upon, suddenly, to use the periscope on the surface of a nighttime ocean.

Suddenly a klaxon sounded over the ship's speakers and a voice said laconically, "Dive, Dive."

I tensed a little. It is one thing to rip along on the surface in bright sunshine, and another to bore down into the black and silent depths. Earlier, crew members had jokingly filled me with horror stories. You can sink a submarine when she's cruising very deep merely by flushing a couple of toilets and leaving the flush valve open. The refrigeration gas, Freon, when exposed to heat, turns into phosgene and hydrofluoric acid, two of the most deadly chemicals known to man. When a submarine exceeds its "test depth" (the depth below which the sea pressure is too great for the hull to withstand) it does *not* spring exciting

leaks that can be hastily calked in movie style. It rips apart.

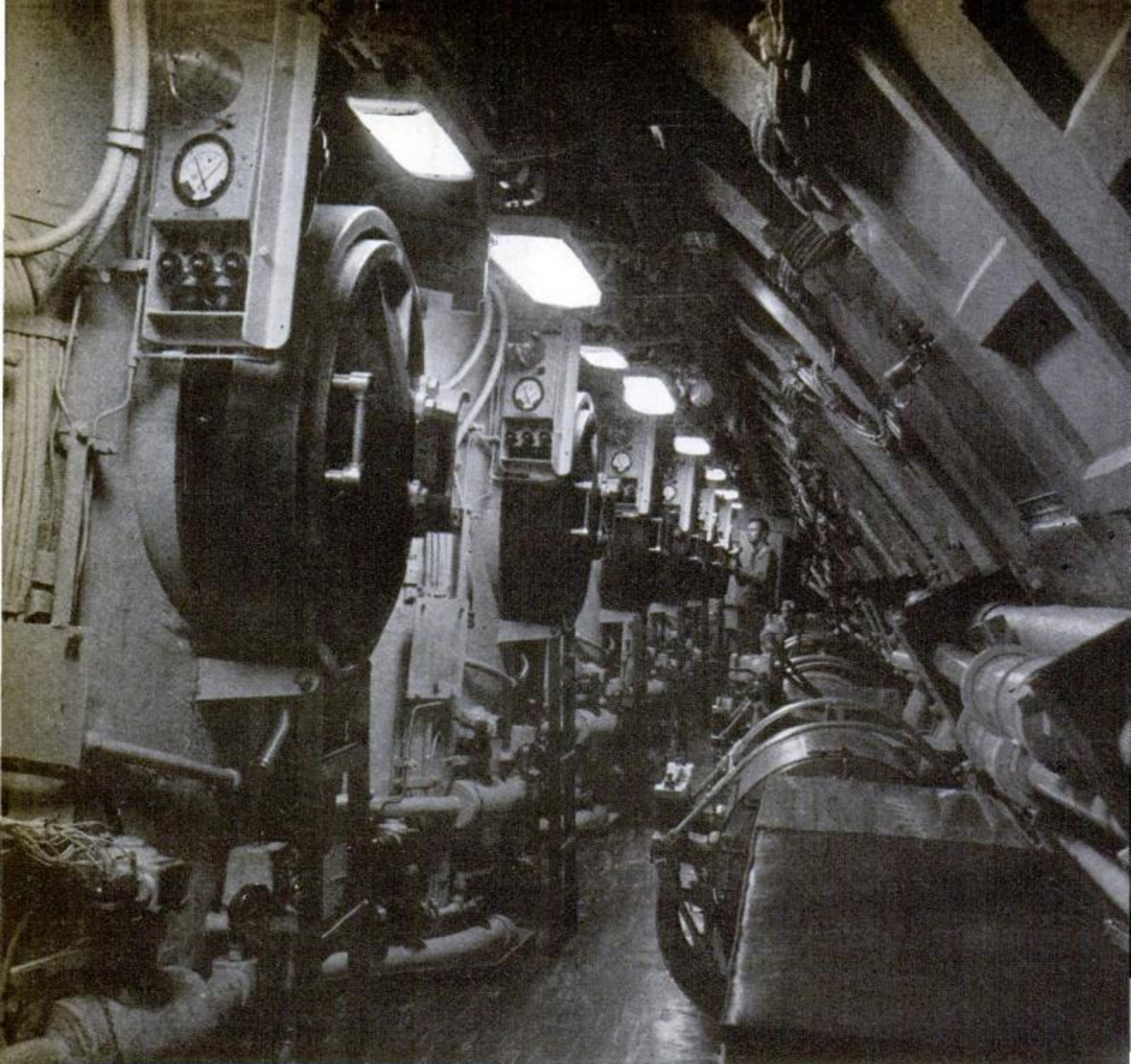
"It's as if a strong man took a banana in his two hands and suddenly gave it a hard twist—and came away with two mushy stubs!" said Lt. Cmdr. Denver McCune, assistant weapons officer.

But the dive was anticlimax. The only change was that the ship became steadier, now that it rode in the depths and not on the choppy surface.

**Firing a Polaris.** McCune gave me a tour of the huge three-decked compartment amidships where the 16 Polaris missiles ride erect inside their launching tubes. Firing a ballistic missile from beneath the sea and hitting the target is one of the most complex operations known to man—so we will hit the high points only. First, the skipper of the submarine must know *exactly* where he is on the globe at the time of firing.

This is accomplished by a roomful of gadgetry known as SINS—Ship's Inertial Navigation System. Delicate accelerometers and memory circuits remember every move the sub has made since the





*This is one alley through "Sherwood Forest," where the big missile tubes line up like great metal tree trunks. Access doors in the sides of the cylinders allow missileers to check and adjust intricate parts of the IRBMs within.*

last check. Star fixes are also made periodically and instantly fed into a computer (to avoid any lag between fixes). The computer spits out a position through its thousands of winking lights (it looks like a pinball machine in action) within a couple of heartbeats. The position is then fed into the ballistic controls of the warbirds to be fired.

The Navy has worked out a highly saboteur-resistant system of locks, checks, and other roadblocks designed to prevent some madman (or a combination of them) from starting World War III. But

even with the entire crew working as a team, the firing of a Polaris is a complicated operation. Let's take just one missile, to make things simple.

The firing tube must be pressurized with air to pop the bird free and whoosh it up to the surface. Down in the bottom of the ship is the Weapons Control Room—a place solid with consoles and manned by officers and men who have spent many months learning what all those flicking needles, flashing lights, and fluctuating dials mean. Only when there is a "green board"—everything op-



erating correctly—does the red firing button that consigns the Polaris to the starry blackness of outer space get mashed by the weapons supervisor.

Here is how the Navy describes it from that point: "Using extremely precise gyroscopes, accelerometers, and its own electronic computer, the guidance system puts the missile on correct course at the time of launch. Should the missile be moved off course by high winds or other effects, the guidance system automatically computes a new correct course and puts the missile on it. The guidance system also maintains stability of the missile in pitch, yaw, and roll planes. At the precise instant required, the guidance system shuts off the rocket motors and triggers separation of the re-entry body (the warhead)."

A Polaris missile can be fired within a few minutes after an order is received from the President of the United States. They can be sent out at one-minute intervals. A shower of missiles can be aloft at once, to fall on widely separated military targets, or concentrated on a single military objective. Or a Polaris submarine can hold its fire until any nuclear war has run its course—and then mount a devastating final attack against any enemy bastion that is left. Nobody is going to knock out the Polaris submarines by return missiles. They are the safest bomb shelters known to man.

**Food fit for a king.** The main problem in a sub like the Edison is not its mechanical and electronic systems. It is the morale of the crew. Every person on board is a volunteer, but 60 days in an air-conditioned jail can get terribly boring. Chief Blanchard, boss of the mess on the Edison, does his best with the food. For snacking up, he runs a popcorn-and-thickshake operation guaranteed to put two pounds a day on anybody. He puts out five kinds of sandwiches for those who wish to fill the crevices left by the thickshakes.

At mealtimes Blanchard takes off the wraps. Iced-shrimp cocktails, juicy broiled steaks, golden-brown chicken,

[\[Continued on page 208\]](#)

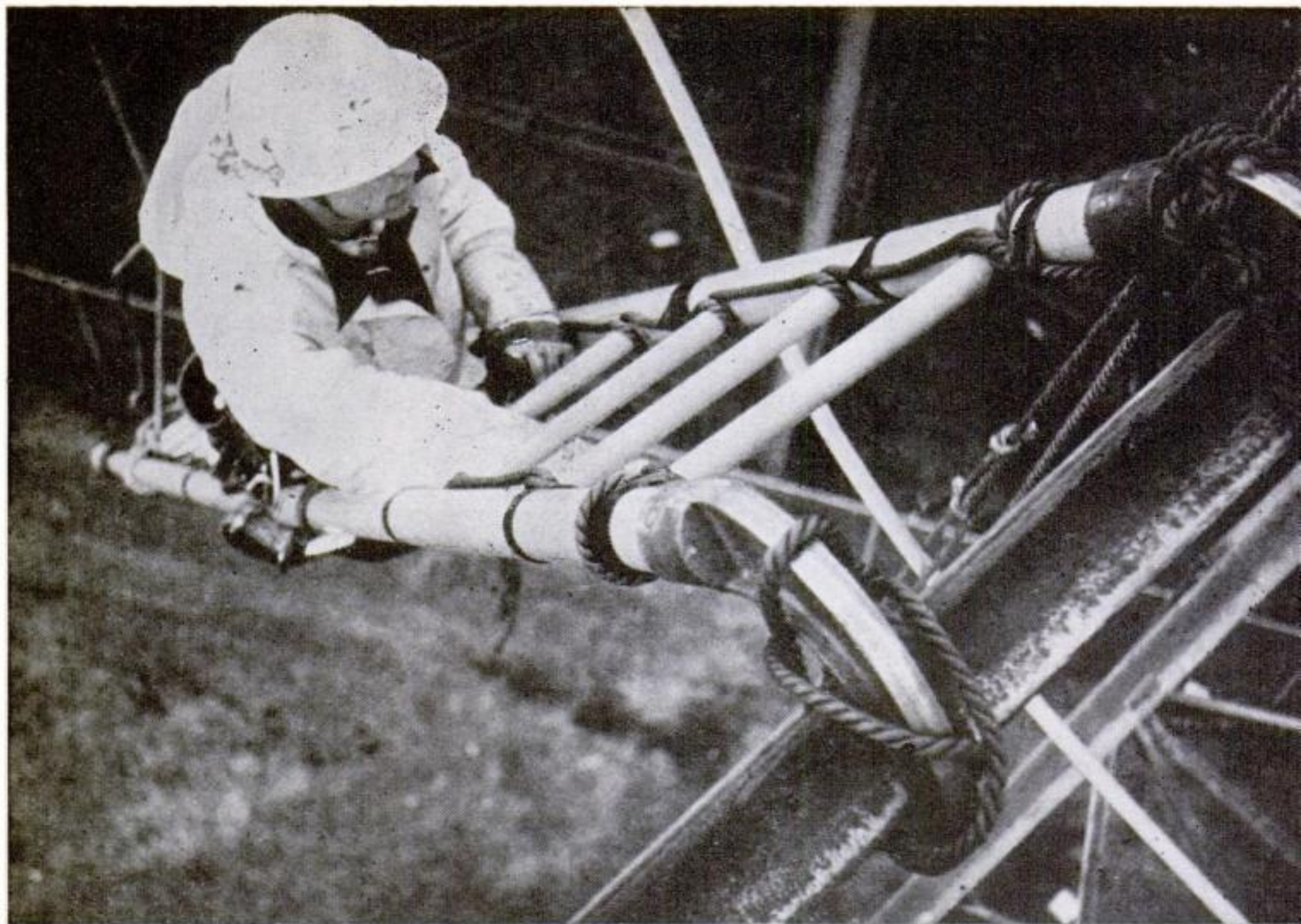


*Dragging leash that secures him to his ship, a sailor stands by during docking. The safety rig, sliding in deck tracks, is essential when seas are running.*



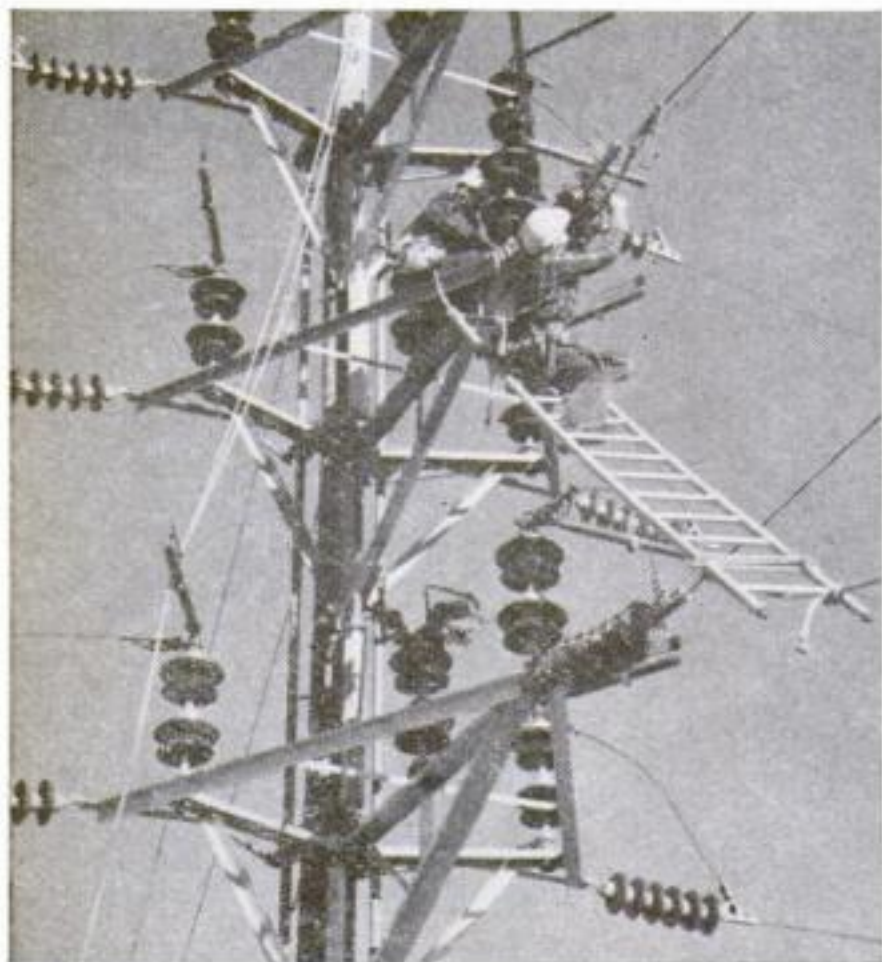
*Plug-in emergency air supplies are spotted all over the ship. They're for damage crews in case smoke, gases, or atomic accidents interfere with normal air.*





Hooked over tower arm and lashed at ends, ladder provides safe footing for nimble linemen.

## Epoxy ladders for high-voltage linemen



In hot-wire network of high voltages and insulators, epoxy ladder is dependable nonconductor.

A new kind of ladder is being used by linemen who work on transmission towers carrying high-voltage wires. Made of a material called Epoxiglas, it's a kind of fiberglass tube, bonded with epoxy resin and enclosing a polyurethane-foam core. The result is a lightweight, resilient, exceptionally strong ladder that won't conduct electricity and is impervious to moisture, rot, and splintering. The material was developed in 1959 for the poles of hot sticks on which linemen mount tools for working on overhead live wires.

Here's how A. B. Chance Co., Centralia, Mo., makes the ladder: Epoxy-impregnated glass strands are wound around and laid lengthwise on the rigid foam core, bonded by the epoxy, and oven-cured. Then the side rails are drilled, filled with epoxy adhesive, and the rungs inserted. The assembled ladder is next given a polyurethane coating. Finally, bronze hooks are joined to the top with epoxy adhesive and rivets, and the bottom is capped with vinyl.





**Radio-controlled decoy** has a tiny receiver in its hollow body to spin battery-operated propeller, turn its rudder, and make ducklike quacking sounds through its speaker.

## Radio-controlled decoy "mothers" ducklings

Ducklings on an experimental farm near Crapo, Md., swim along with a radio-controlled decoy, thinking it's their mother. They were "imprinted" with the decoy, having it fixed indelibly in their memory by being associated with it constantly almost immediately after hatching. Now, in response to noises emitted by the radio, they



follow the decoy as it is propelled about a pond. Dr. Eckhard H. Hess, professor of psychology in charge of the animal-behavior laboratory at the University of Chicago, is conducting the studies on his farm. He has imprinted ducklings, goslings, and other young fowl with human beings and simple boxes as well as mechanical decoys.



## Crow's-nest over Niagara is seven stories high

Newest observation point at Niagara Falls, the 300-foot Seagram's Tower stands atop Clinton Hill in Niagara Falls, Ont. It's 500 feet above the Canadian Horseshoe Falls at right and the American Falls to the

left. Three high-speed elevators can take 1,500 persons an hour through the 200-foot concrete-column base to observation decks on seven levels. The highest deck opens a vast panorama to sightseers.





## Typewriter translates as you speak

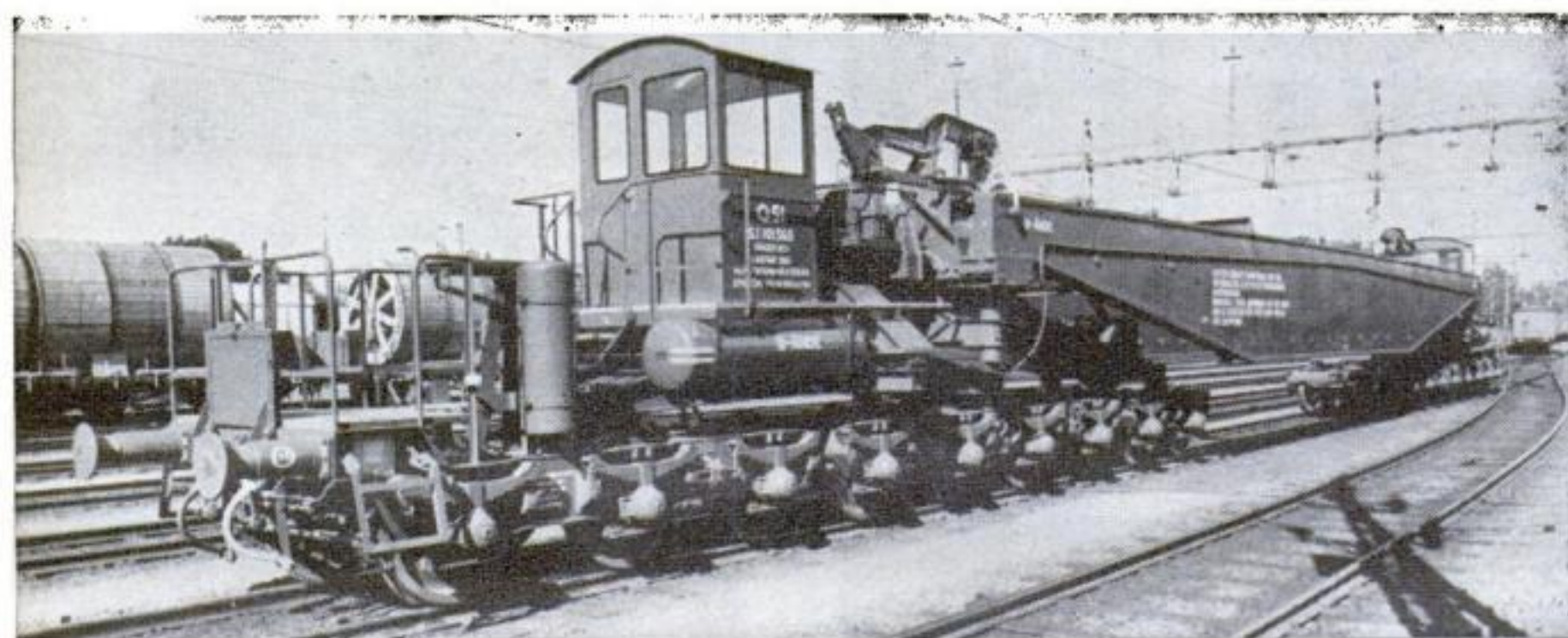
Dictate to this phonetic typewriter in English and it types in French—or two other foreign languages it “knows.” Or speak in French and it will type in English. The RCA machine analyzes speech, converts it to code, translates it word for word, and uses code to operate the typewriter. Still experimental, it handles 100 syllables, one-tenth the capacity needed for a practical system.



## Hip pack totes heavy loads

Carrying an outboard motor single-handed is an easy job if you are wearing a new carrier that puts all the weight on your hips. Developed by Bell Aero-systems engineers, it consists of a flexible styrofoam-padded fiberglass frame that fits above the hips and is held by shoulder straps and a belt.

In demonstrations, the carrier handled loads of 100 pounds with ease, lifted the end of a Volkswagen, and—in pairs—held a Medical Corps stretcher, leaving the bearers' hands free.



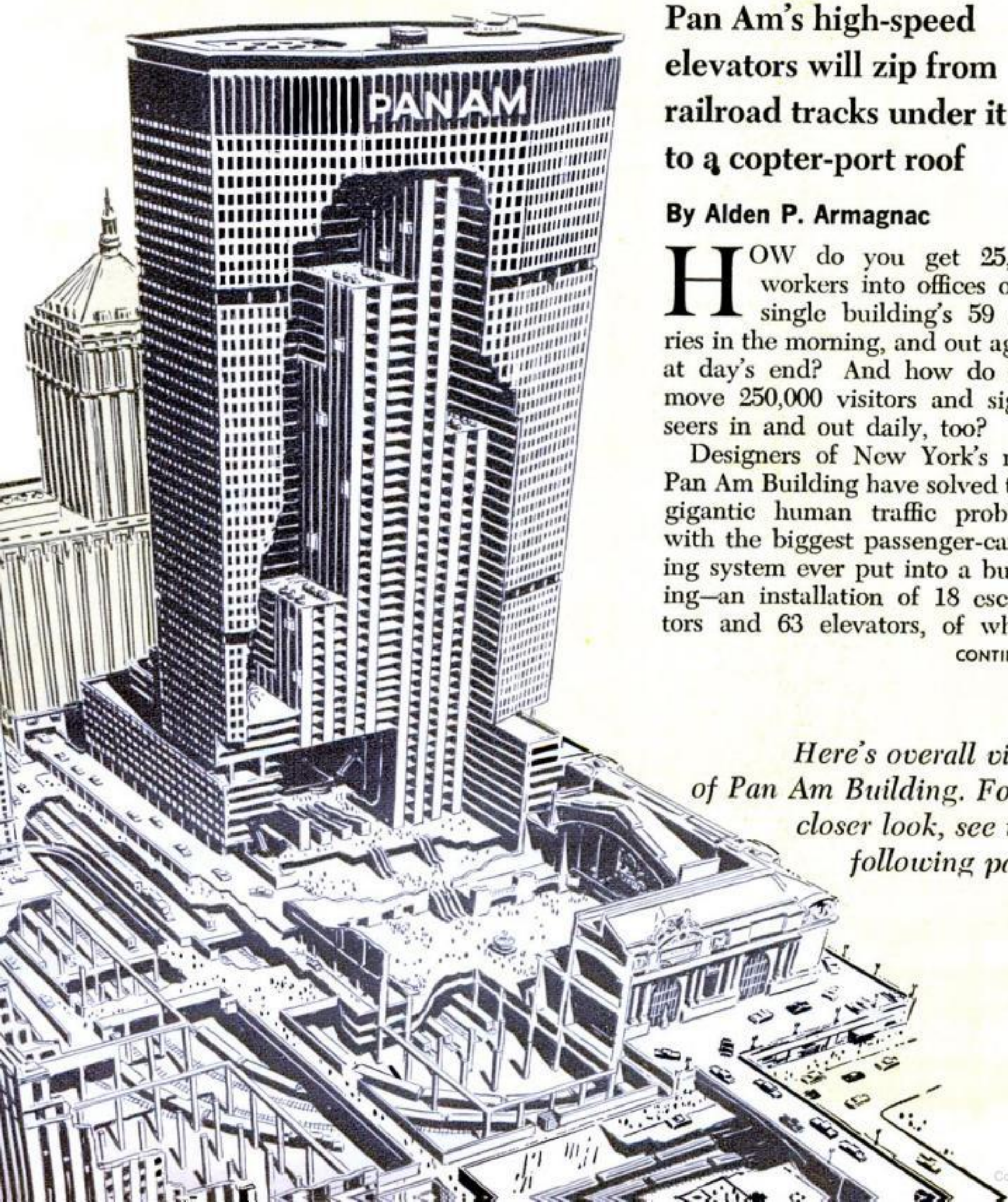
## Big freight car has 18 axles

Sweden's largest freight car is an 18-axle monster 131 feet long, built to transport huge transformers, boilers, and other bulky industrial equipment. It will take loads up

to 260 tons. A cab at each end has phone connections with the locomotive and with a crew car containing four bunks and a pantry. For cylindrical loads, the gondola can be fitted with a central supporting girder or cantilever girders.



# The Most Complicated Building Ever Built



Pan Am's high-speed elevators will zip from railroad tracks under it to a copter-port roof

By Alden P. Armagnac

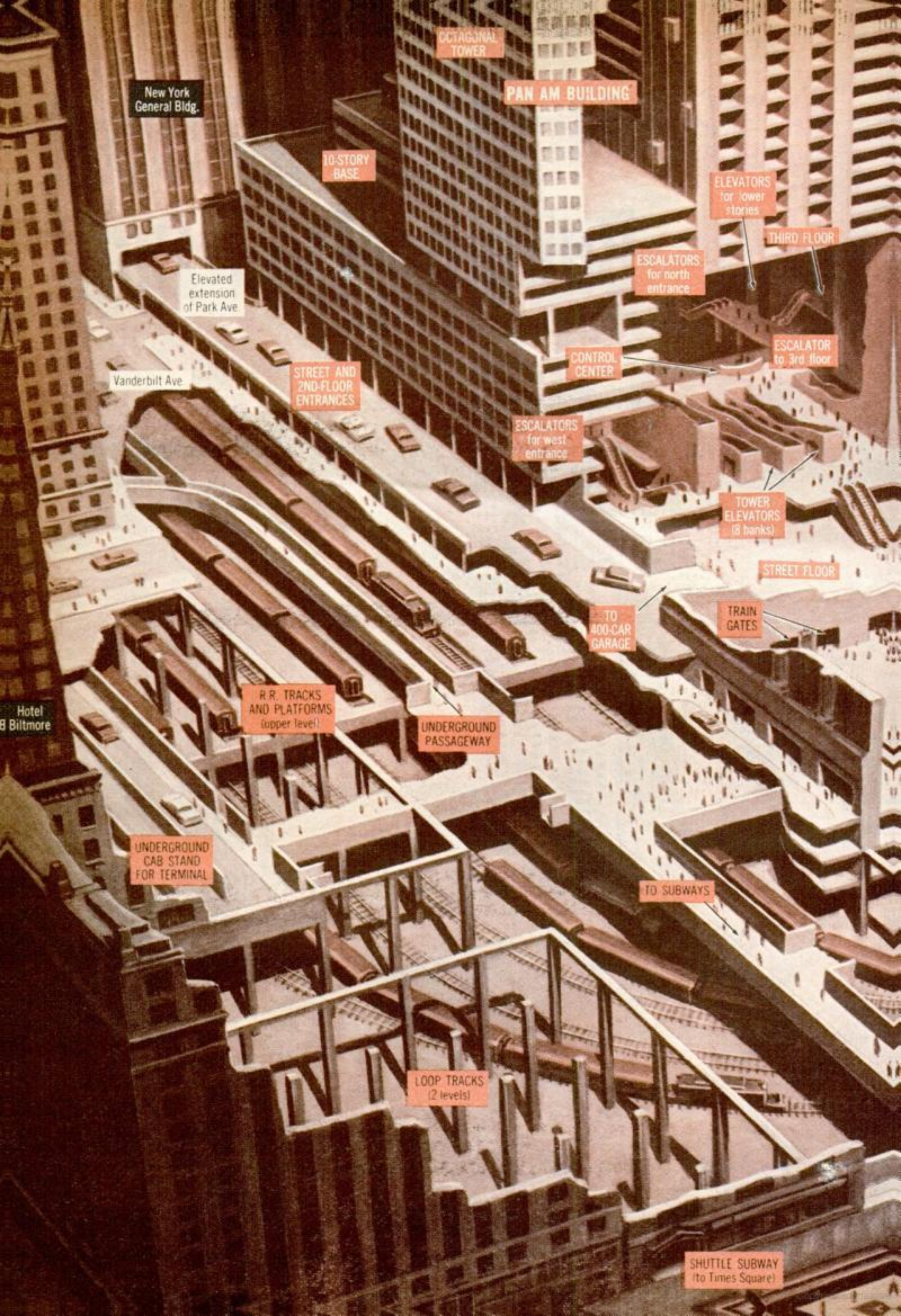
**H**OW do you get 25,000 workers into offices on a single building's 59 stories in the morning, and out again at day's end? And how do you move 250,000 visitors and sightseers in and out daily, too?

Designers of New York's new Pan Am Building have solved that gigantic human traffic problem with the biggest passenger-carrying system ever put into a building—an installation of 18 escalators and 63 elevators, of which

CONTINUED

*Here's overall view of Pan Am Building. For a closer look, see the following page*







How 25,000 office workers and 250,000 visitors will swarm in and out of Pan Am Building daily is shown in cutaway view of new skyscraper, adjacent Grand Central Terminal, and area's underground maze of railroad tracks, subways, and pedestrian passageways. Solving Pan Am's human traffic problem takes 18 high-speed escalators—the largest, four feet wide—and 63 passenger elevators, some traveling as fast as 18 m.p.h.



Graybar Bldg.

Hotel  
Commodore

SECOND FLOOR

MAIN  
ESCALATORS

GRAND  
CENTRAL  
TERMINAL

UPPER  
CONCOURSE

LOWER  
CONCOURSE

R.R. TRACKS  
AND PLATFORMS  
(lower level)

WAITING  
ROOM

PASSAGEWAY TO  
LEXINGTON AVE.  
SUBWAY  
(uptown-downtown)

QUEENSBOROUGH  
SUBWAY  
(crosstown and  
to Long Island)

42nd St.

Park Ave.



the highest-rising are among the fastest in the world. When the 808-foot-high skyscraper opens its doors, early next year, this system will introduce a visitor to its mechanical wonders.

A spectacular octagonal tower on an oblong base, adjoining the Grand Central railroad terminal and rising squarely over the maze of underground tracks that enter it, the Pan Am will be a city within a single building. Its 25,000 office workers will almost equal the entire population of Urbana, Ill., or Butte, Mont.; its daily quarter-million visitors, that of Dayton, Tampa, or Tulsa.

The world's largest commercial office building, it boasts 2,400,000 square feet of floor space—exceeded only by the Pentagon in Washington and the Merchandise Mart, not exclusively an office structure, in Chicago. And record making in Manhattan office-leasing history was the renting of 15 stories to Pan American World Airways, the principal tenant, for which the skyscraper has been named.

**Vertical metropolis.** Occupants will consume enough electricity for 10,000 homes: 120,000 kilowatt-hours daily. Their phone calls will require a whole new telephone exchange—one put right into the building. They'll be kept comfortable in hot weather by the biggest air-conditioning system in the world.

And this city-in-a-building will be superimposed upon one of the most congested spots on earth—the meeting place of a great 450-train-a-day rail terminal, three jam-packed subway lines, snorting buses, scurrying taxis, and surging crowds of people.

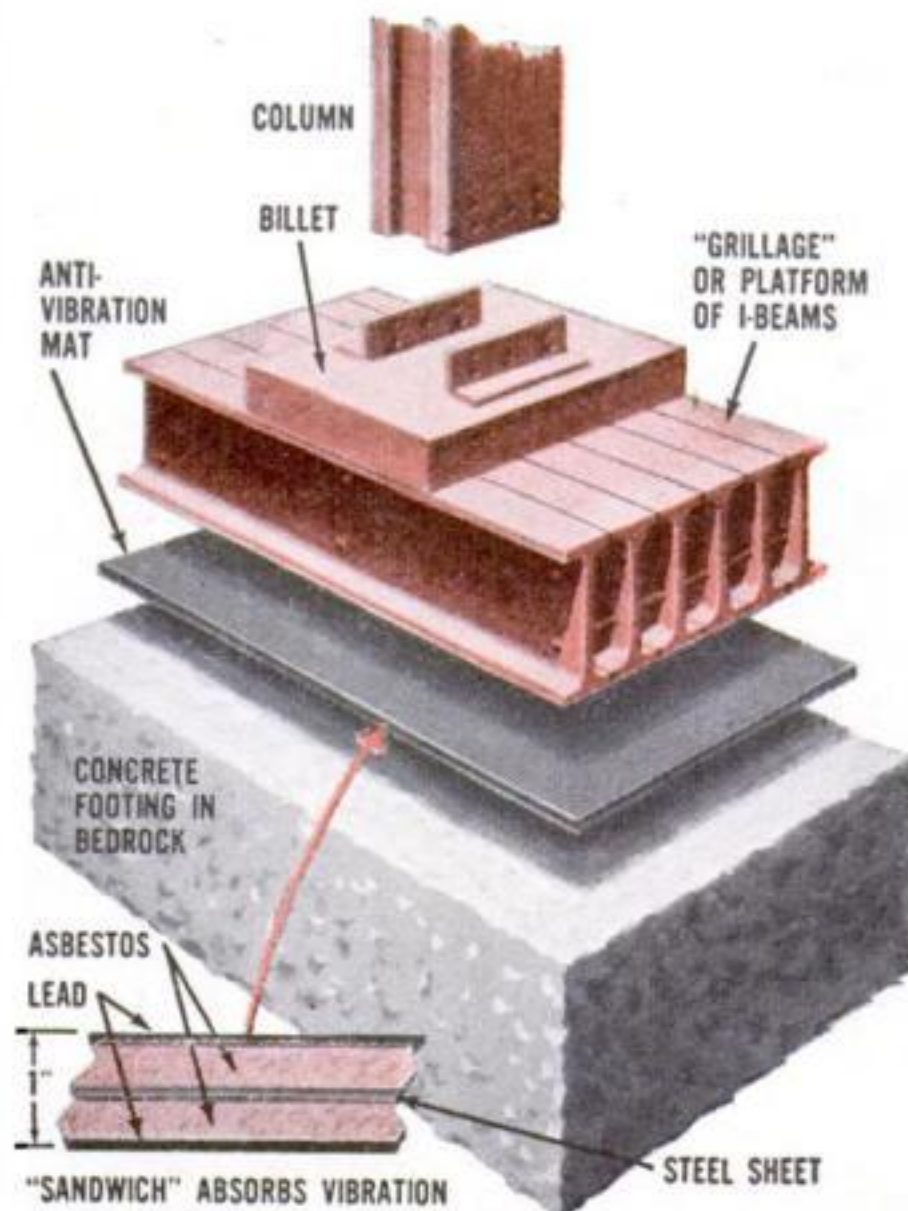
To help the Pan Am's own swirling tides of humanity bypass others, four of the building's biggest escalators connect it directly with Grand Central Terminal's upper level. Stepping from a train gate to an "up" escalator (as three of four will be, in the morning rush hour), a commuter will be whisked at 120 feet a minute to the Pan Am's street floor. A few steps more, and another high-speed escalator lifts him to the second floor, where elevators start. Additional esca-

## Skyscraper had to be built around running trains—and shielded from their vibration, too

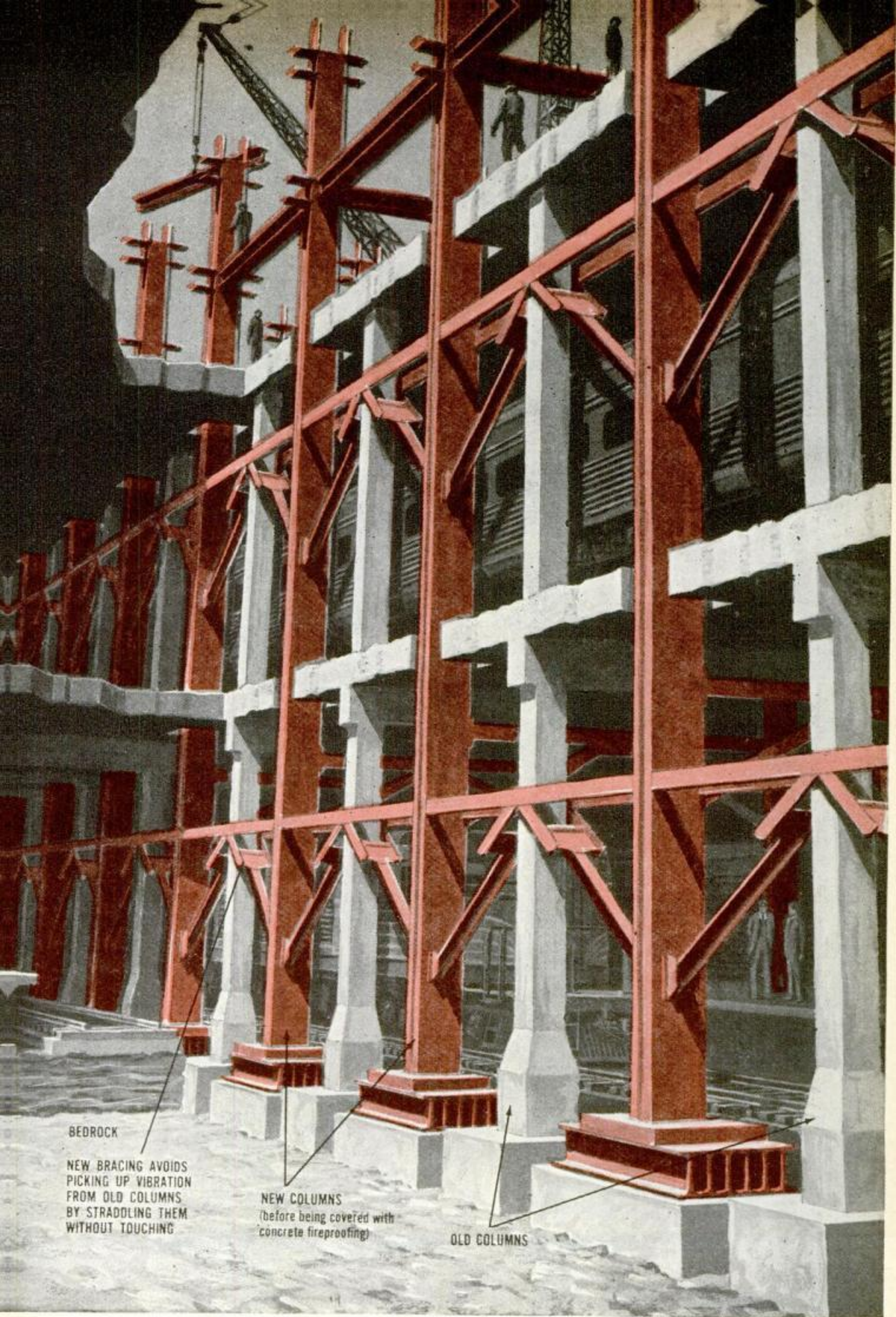
Builders performed fantastic feat of erecting Pan Am Building's underpinning (facing page) while trains rolled around and through it, unhindered. Other buildings have jugged over terminal's network of rails, but this one was an "island" surrounded by them. So tight was space that tower's columns had to be lowered "naked"—without usual pre-attached fittings—through holes cut in ceilings and station platforms of two underground train levels. Footings (below) for columns, between tracks and under platforms, were set in excavations laboriously chipped (no blasting here!) from bedrock 55 feet below street level.

All but street floor of Pan Am Building was insulated from vibration of moving trains. Footings of new columns included special vibration-absorbing mats. Crossbracing avoided touching old columns—which alternate with new ones—by straddling them with unorthodox structural fittings (large view).

Pan Am Building's street floor—which old columns now support, instead of razed Grand Central Terminal Office Building of six stories—has no physical connection with new building's vibrationproofed upper stories. Even the partitions of Pan Am Building's street floor are hung from its second story.







BEDROCK

NEW BRACING AVOIDS  
PICKING UP VIBRATION  
FROM OLD COLUMNS  
BY STRADDLING THEM  
WITHOUT TOUCHING

NEW COLUMNS  
(before being covered with  
concrete fireproofing)

OLD COLUMNS

CONTINUED





TV cameras in walls and ceilings stand guard over people on escalators. Should anyone fall, monitor screen instantly alerts control center

lators, serving west and north street-level entrances, link the street, second, and third floors of the three-story lobby. The Pan Am's escalators will be able to carry about 50,000 people an hour.

Banks of automatic elevators will

to stop escalator. Cameras also aid in varying escalators' up-or-down patterns to suit flow of human traffic at different times of day.

speed up to 20,000 people an hour to and from the higher floors. Six elevators will run to the top floor at more than 1,600 feet a minute, or 18 m.p.h.

**Offbeat time clocks.** Slightly staggered office hours will spread out workers' arrival and departure times. With that much help, the capacity of the speedy escalators and elevators is expected to avert traffic jams at nine and five. Three restaurants within the building will ease the lunch-time rush to eating places outside.

Taxicabs and private cars, swinging off an elevated section of Park Avenue, will unload and pick up passengers at second-floor entrances to the building. Motorists may park cars in a 400-car multi-level garage, starting at the second floor, in the building's southeast corner.

Having provided for people coming by road, by train, and afoot, the designers went on to anticipate arrivals by air. The Pan Am's flat roof has been given the needed structural bracing to serve

[\[Continued on page 216\]](#)



Proposed helicopter port on Pan Am Building's rooftop would be New York's first airport in heart of city. First helicopter test flights from roof have been scheduled for fall of '63.





Queerest contraption on the Mississippi, said natives as the outrigger docked at Louisiana, Mo.

## Outrigging in an ordinary canoe

Using a conventional canoe as a base, 23-year-old Gary Grandstaff of Des Moines cobbled together an outboard-powered double outrigger. In it, with the five-horse engine chugging, he traveled the Mississippi from Keokuk to New Orleans.

Styrofoam in the two pontoon casings and in the stern and prow of the canoe itself give the craft excellent buoyancy. A plywood deck over the hull covered two storage compartments: one forward to hold 10 gallons of gas, a larger one aft for supplies—pup tent, sleeping bag, life preserver, fishing gear, fresh-water jugs, and food (mostly canned peaches, sardines, and bread). Near the top of the heap he kept a camera and diary.

Grandstaff keeps a paddle handy for maneuvering when docking. Brackets on either side support a mast for a sail should the motor conk out. Total cost of the craft was \$225, of which \$125 was for the second-hand canoe. Gas and supplies for the trip ran \$50 more.



Access to holds under the canoe's plywood deck is through two boxlike hatches at the stern and bow.

## On a bicycle built for five

The rear fork and wheel were sawed off one bicycle and the front fork and wheel off another to make this double-sprocket family bike for the Coolidge Holts of Manchester, Tenn. Holt then welded the frames together, lengthened the chain so that two could pedal, and added three seats.

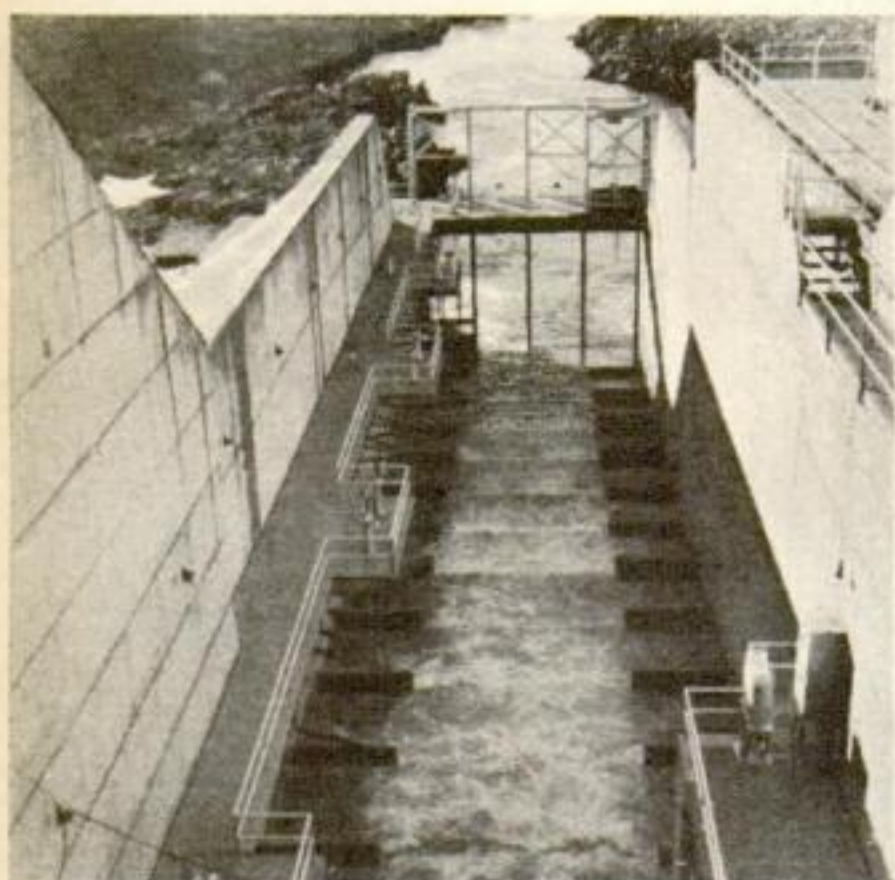
At right his entire family goes for a ride—the three little girls free-wheeling.



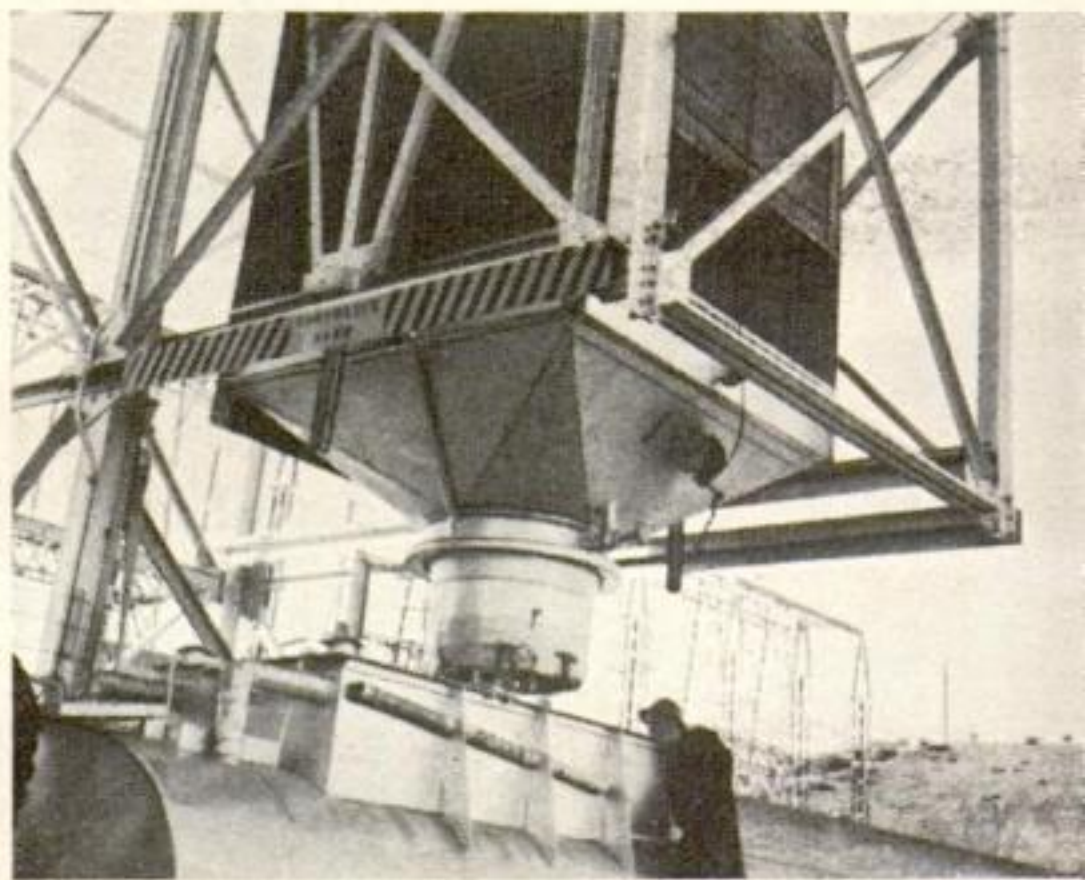




Experts select salmon that are ready for spawning. Some fish weigh as much as 40 pounds.



**1** Fish ladder above draws salmon into huge steel elevator waiting at water level, door open, to carry them to the hatchery.



**2** Filled elevator rises to top of dam, then moves from shaft along overhead tracks into position for emptying into waiting truck.



# Salmon Take Taxi to Spawning Grounds

**P**ROGRESS is like medicine; it cures the ailment but occasionally brings on undesirable side effects. The huge Shasta Dam on the upper Sacramento River is an example.

The dam was built to irrigate the surrounding valley—but it also provided a threat to the central California salmon-fishing industry. Along with the secondary Keswick Dam a few miles downstream, it blocks off four major salmon-spawning streams.

Each spring and fall thousands of chinook salmon run up the Sacramento. Many turn off at Battle Creek (see map) and end up at Coleman Hatchery. Here they are impounded and artificially spawned. But nearly half continue upstream. At Keswick Dam they run into a dead end. Problem: getting the fish back to the hatchery for spawning.

The solution is an elaborate taxi service. An elevator lifts the fish from the

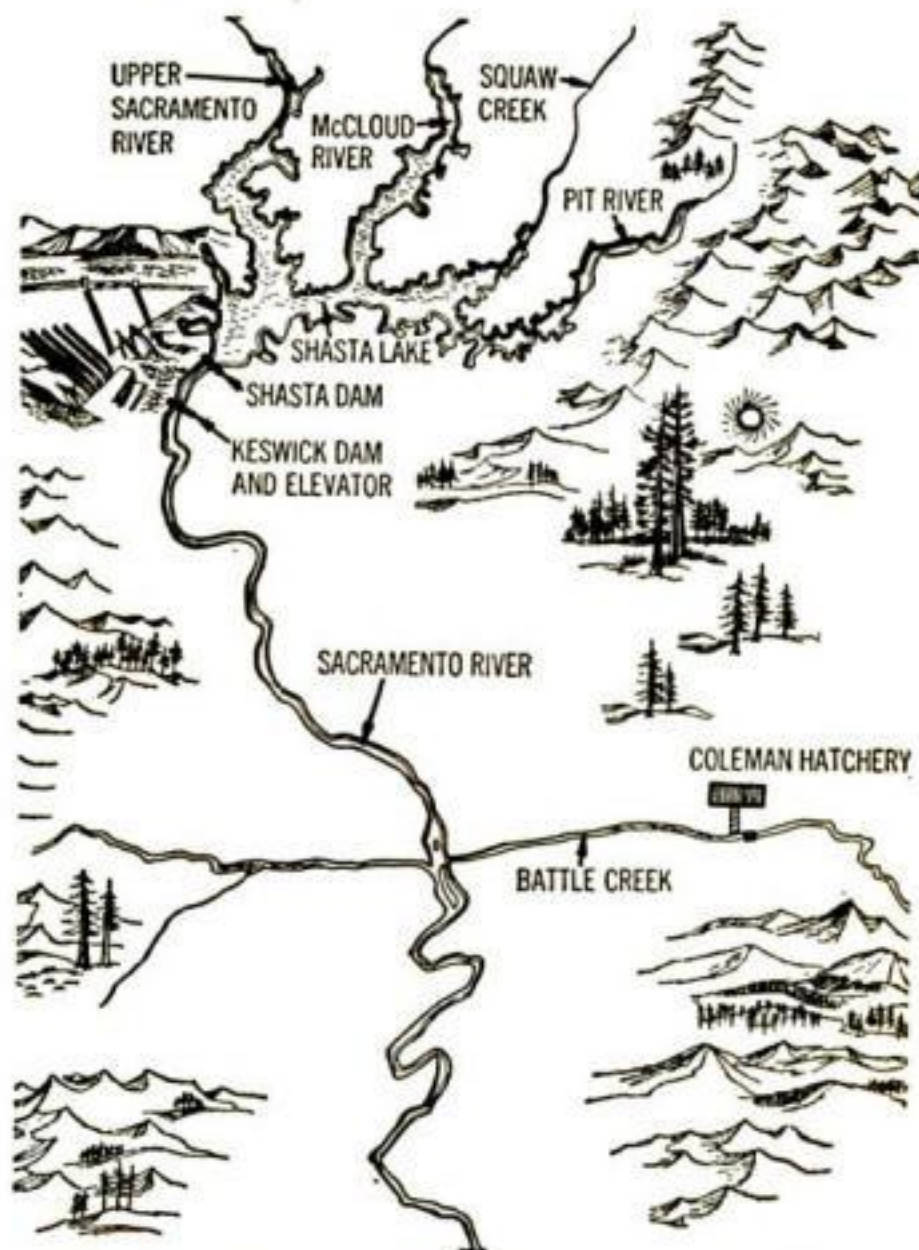
trap at water level at the dam and loads them into two tank trucks. The trucks ferry the fish to the hatchery.

Each two-truck run carries about 200 fish. Of these, half are ripe females, which yield 15 to 20 million eggs. The eggs are hatched, and a year later the young fish are released down the hatchery spillway headed for the Pacific Ocean. Yearly output, including taxed fish and the catch from Battle Creek, is about 30 million salmon.

In the San Francisco Bay area alone, salmon fishing brings in \$3,500,000 a year. Without the taxi service, this important industry would be badly hurt.  
—Harry D. Bishop.



**3** Truck unloads at Coleman Hatchery, 30 miles from dam. Water, emptied with thrashing salmon, protects them from injury.



Four spawning streams—upper Sacramento, McCloud, and Pit rivers, and Squaw Creek—are blocked by Shasta and Keswick dams.



# What Makes the Moon Look So Big?

The long-standing mystery of a striking sky illusion has finally been solved

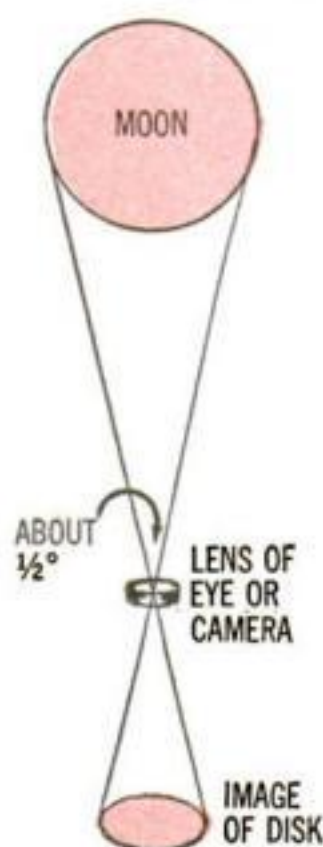
**T**HAT great big moon hanging just above the horizon, magnified to twice its usual size, is an optical illusion. A magical sight to delight romantic couples, it also has puzzled down-to-earth scientists for centuries. Now the mystery of what causes the illusion has been solved at last.

A trick of perspective is responsible, announce two psychologists who have reproduced the "moon illu-

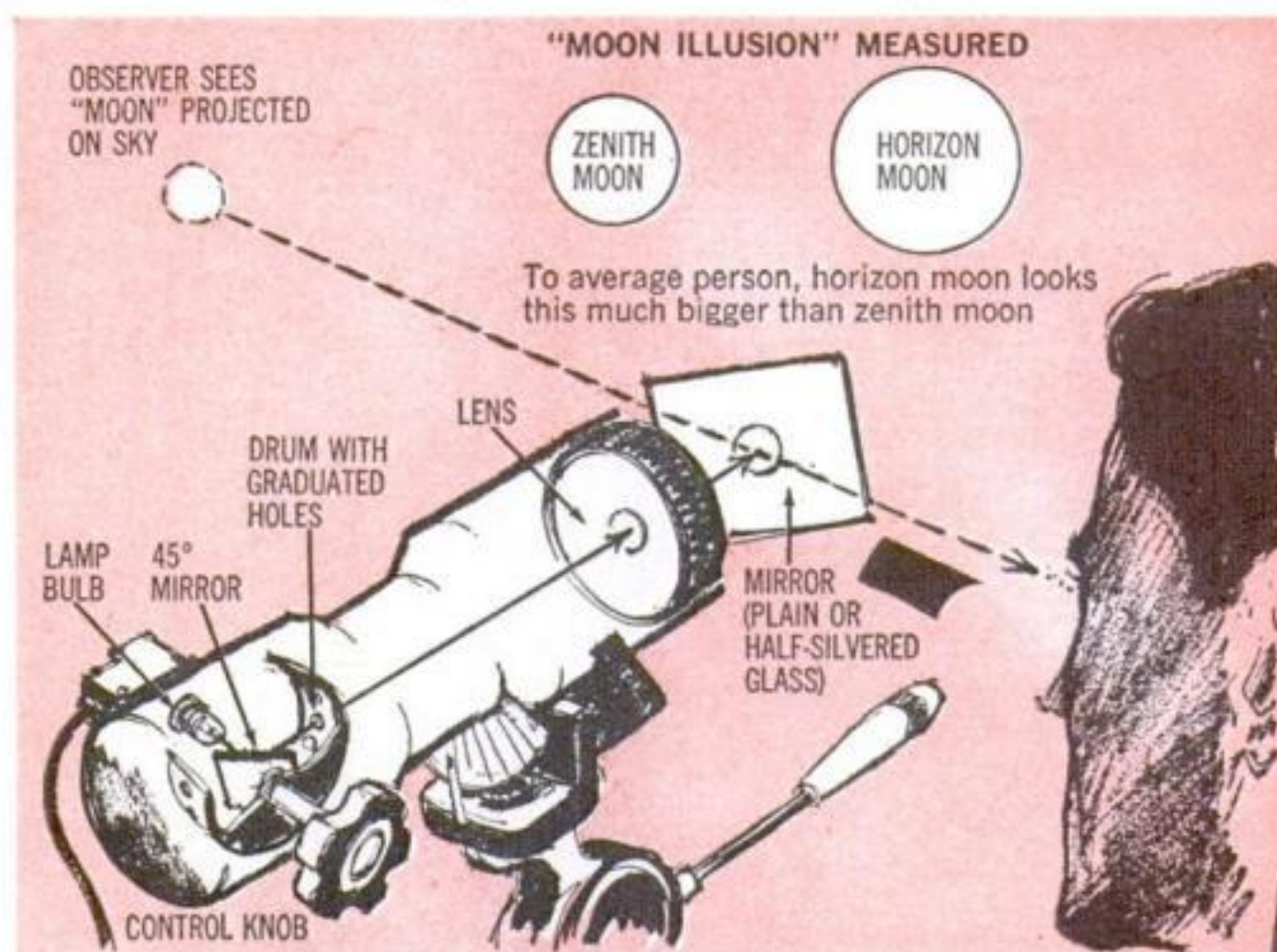
*[Continued on page 202]*



**Moon's magic—an optical illusion—was reproduced with this ingenious device**



**Oversize moon** has to be an illusion. Moon's diameter and distance immutably fix angle it occupies in field of view—about half a degree. So, high or low, moon measures the same in photos. Only to human eyes does its size seem to vary.



**Mysterious "moon illusion"** yielded its secret when made to order by this artificial-moon projector. Lamp bulb, holes of graduated diameter, and lens form luminous disk of variable size. Observer, looking in oblique mirror, sees this "moon" projected over landscape. Using two projectors to put "moons" high and low in sky, he alters size of one disk to match other. Trial settings show diameter of "horizon moon" looks  $1\frac{1}{2}$  times as big as that of equal-size "zenith moon" (inset).

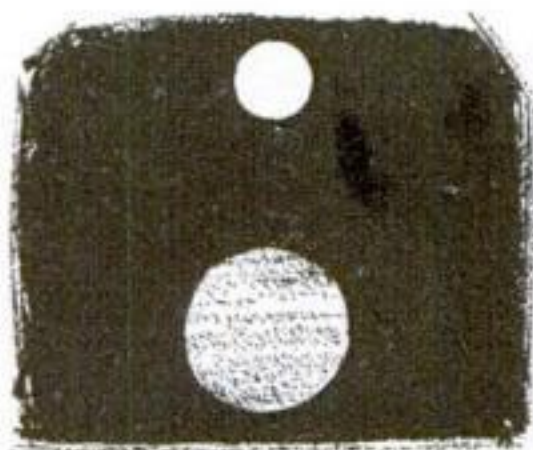




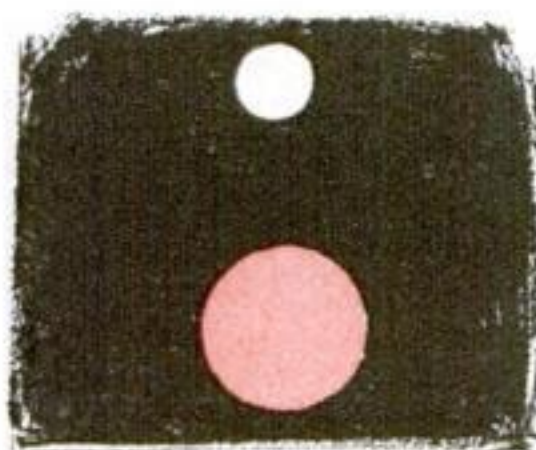
Out go these notions of illusion's cause . . .



Earlier experimenters, reporting no illusion on raising head (left) to view zenith moon, thought it caused by lifting eyes (right). New findings refute both of these.



Greater brightness of zenith moon was suggested by Irish scientist, but eliminated in trial, as possible cause of moon illusion.



Red hue of low moon was proposed as factor in illusion—but ruled out by trial employing red color filter on one of the projectors.

and this proves the answer

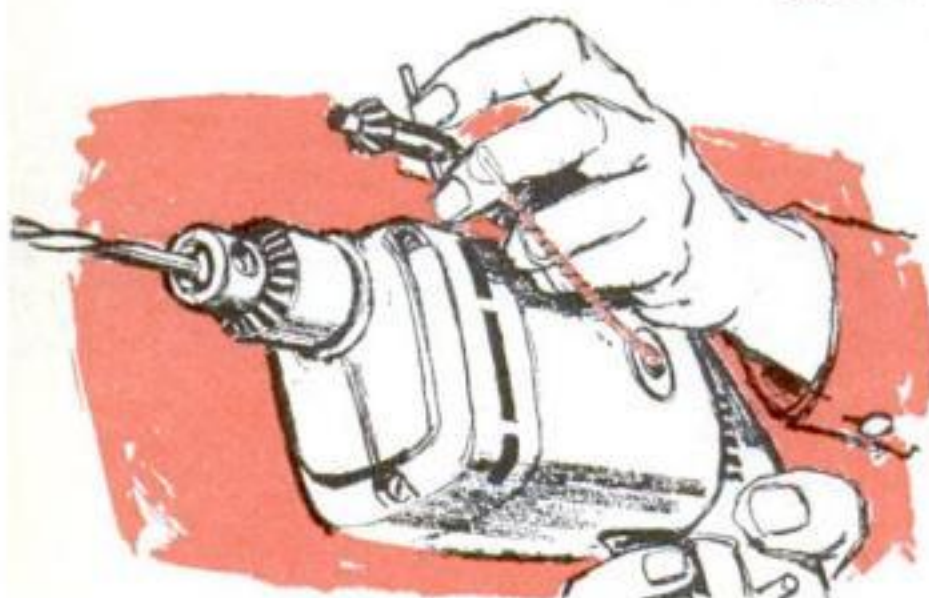


**Mystery's solution:** Low moon looks big compared to distant terrain—by same principle of perspective that makes man or giant of equal-size outline.

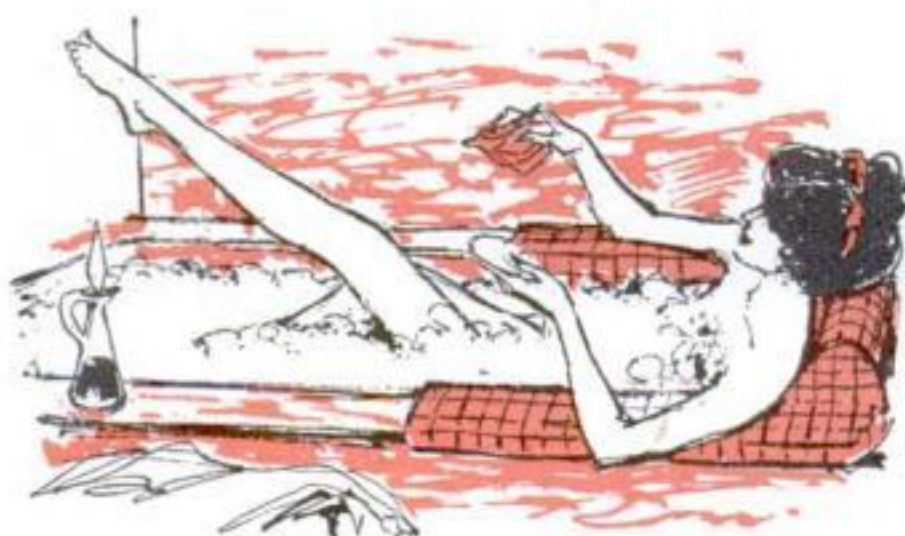


# "I'd like to see them make..."

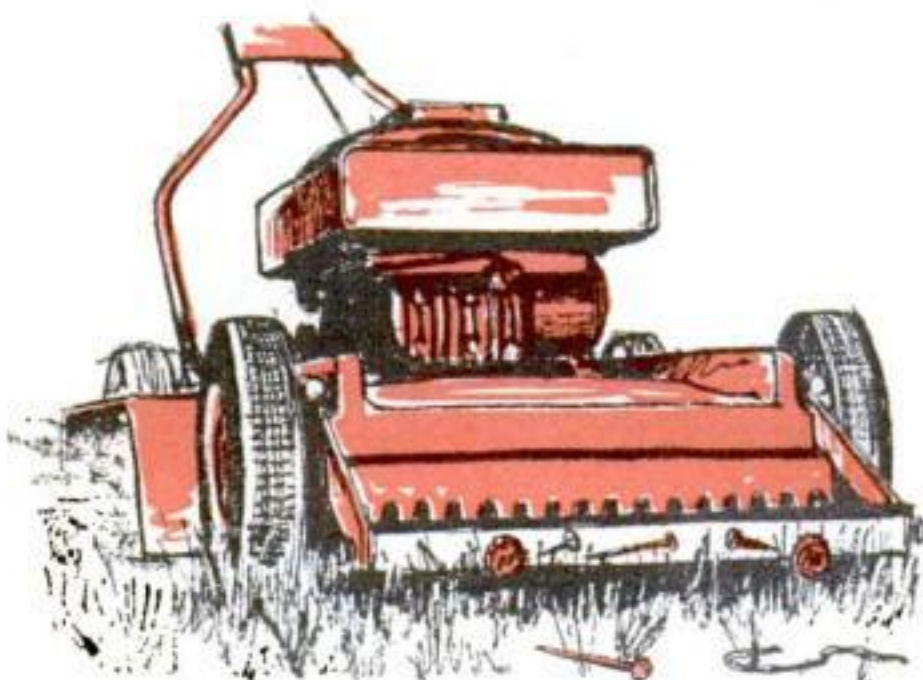
No-rock camping gear with telescoping legs like those on camera tripods. You'd lock each leg at the right height so the equipment would stand level on bumpy or sloping ground.—Skip Mosher, Rialto, Calif.



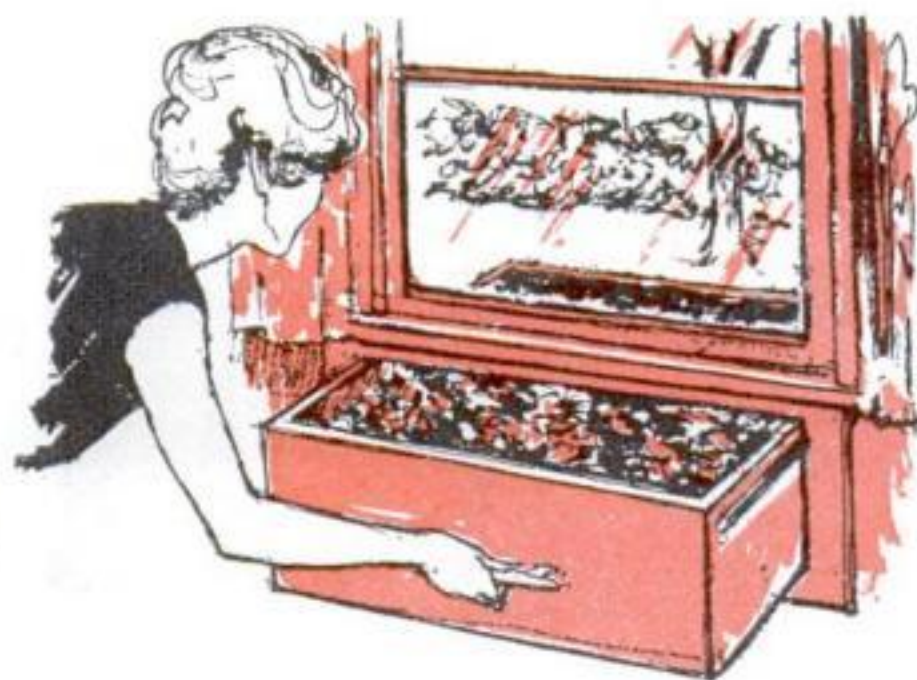
Chuck keys for hand drills on a recoil cord housed inside the tool. Then the cord wouldn't tangle in the drill and the key couldn't be mislaid.—John Overby, Osburn, Idaho.



A plastic foam-filled pad shaped to fit a standard tub so you could soak out muscle pains in comfort. It should be thin enough to fold for storage.—Mike Patterson, Dallas.



A magnetic pickup bar on the front of power mowers to prevent nails, bits of wire, and other metal objects from being flung outward by the blades.—Harry Randall, Bessemer, Ala.



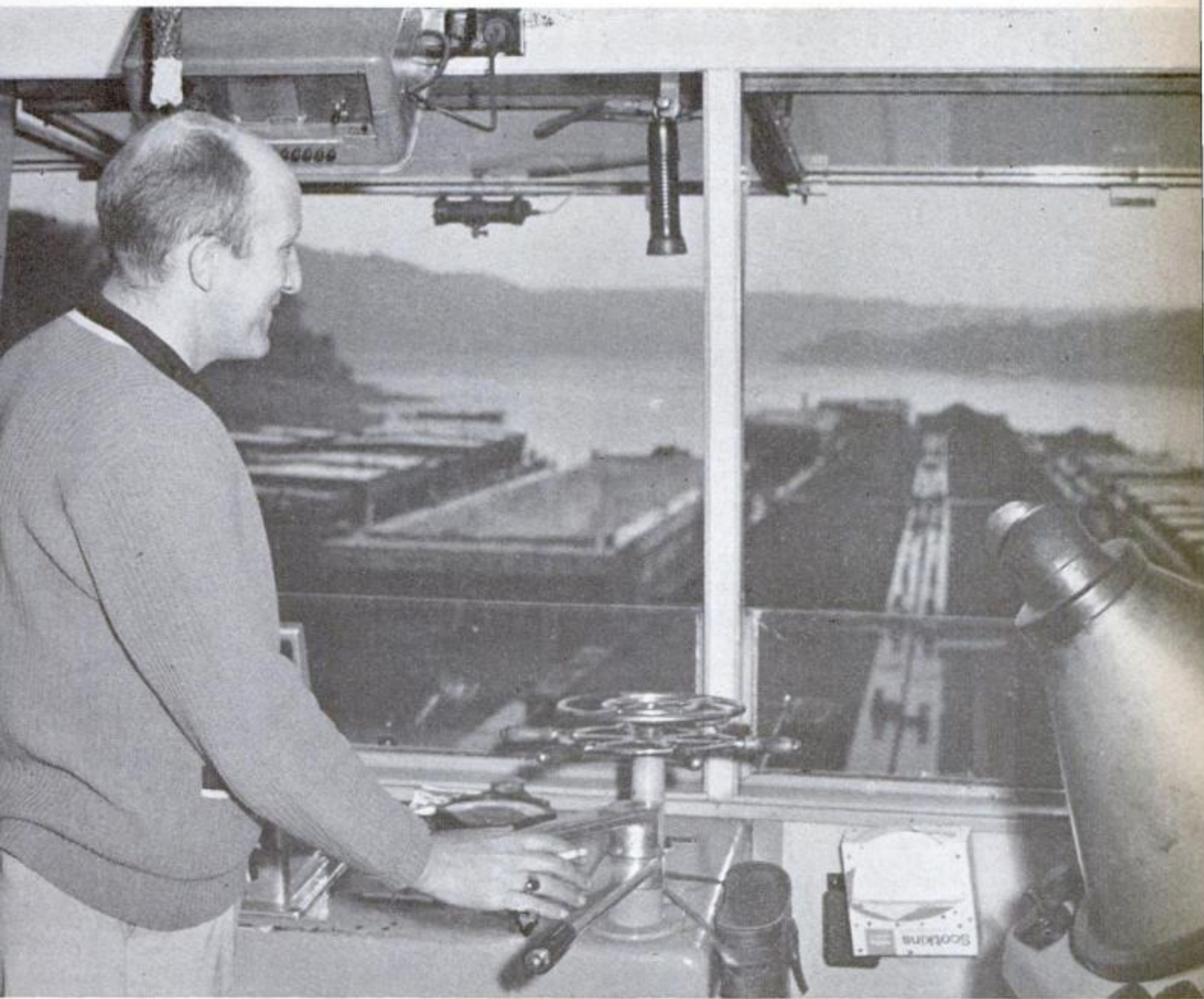
A sliding plant stand that could be built into a window. You'd push it outdoors so the plants could get an airing when the sun is warm.—Deborah Johansen, Nelsonville, N.Y.

Everyone has his own pet idea of a gadget that he would like to see in general use. What's yours? We will pay \$5 for each one published. Please use Government postcards

only. Send to ILTS Editor, Popular Science, 355 Lexington Ave., NYC 17. Write your name and address clearly. Contributions cannot be acknowledged or returned.



# The Other Fellow's Job



**River-boat skipper** The envy of every small boy on the banks of the Ohio River, James Gibeaut of Point Pleasant, W. Va., stands proudly in the wheelhouse of the river boat he commands. Once one of those small boys himself, Captain Jim is now master of a towboat that pushes freight barges on the river he loves.

How do you get a job like that? Jim Gibeaut, like almost all river-boat captains, did it the hard way. He signed on as a deck hand as a boy of 16, and worked his way up. Now 35, he earned his pilot's license seven years ago, won the rank of master last January. This gives him full responsibility for guiding the huge cargoes

to their destination for the Ohio River Co.

A landlubber might look on his job as a sinecure: shifts of six hours on and six hours off for 30 days, then shore leave for the next 30 days. Where else could you get a salary of up to \$12,000 for six months' work? And the living is good on the river today: the best of foods well prepared, a comfortable cabin, and clean linen.

But it's not all beer and skittles. Captain Jim's responsibilities are grave. He must have a feel for the effect of wind and current on the tremendous weight he is piloting. He must maneuver his load expertly into and out of tight spots—and watch the river constantly for carefree boaters and water skiers.

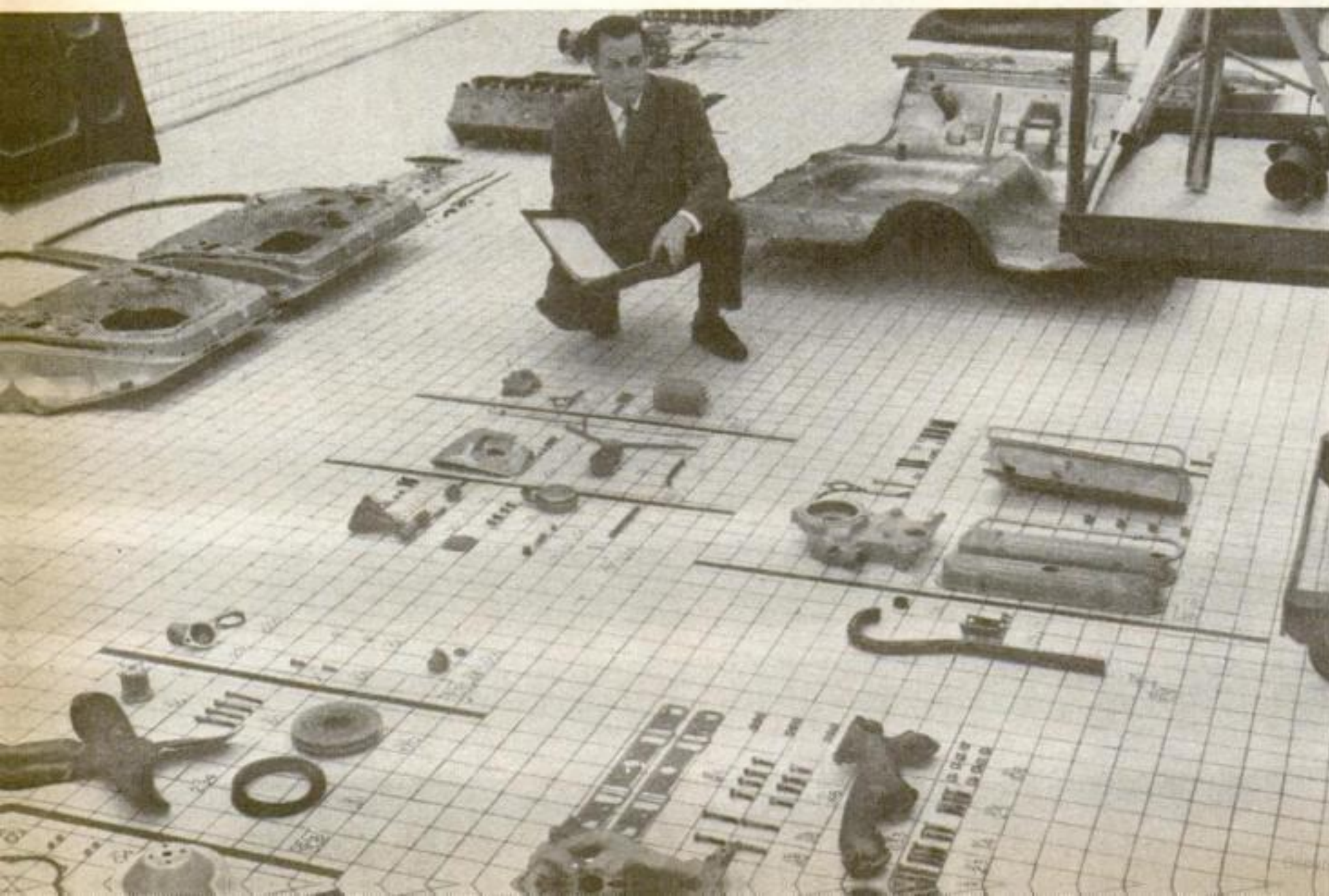
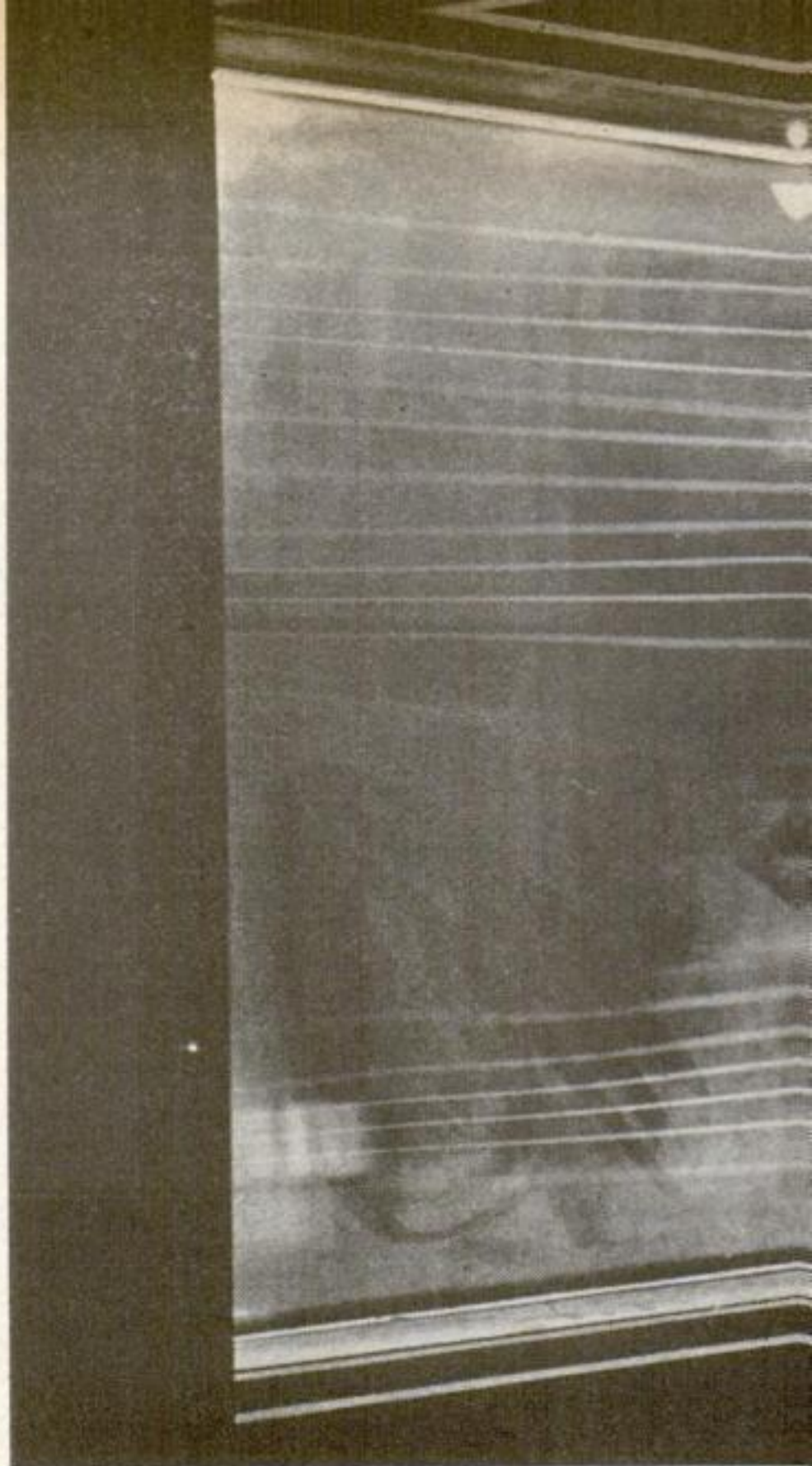


## The Other Fellow's Job . . . continued

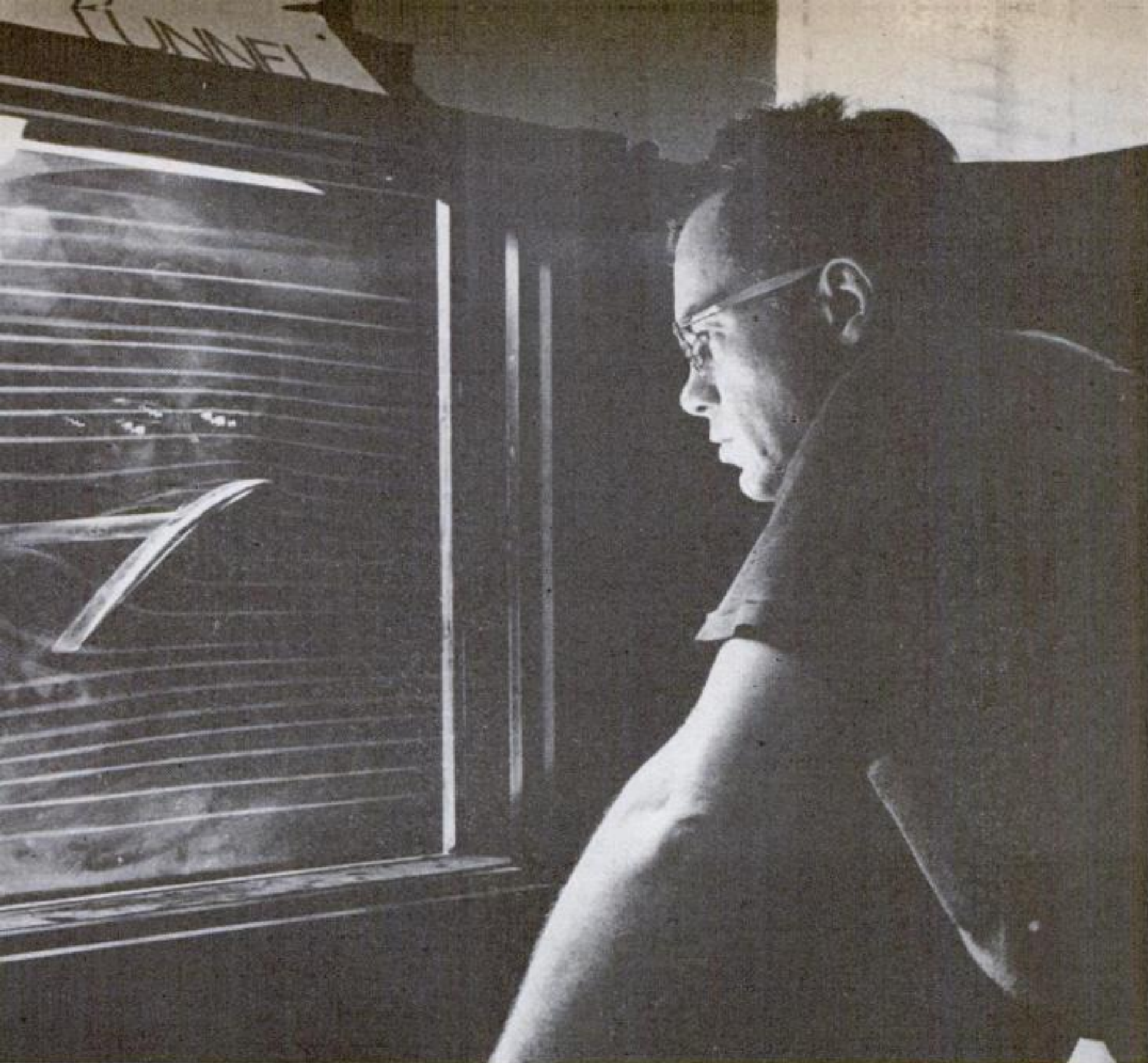
**Disassembly line** Among his other duties as a Ford senior research-test technician, George F. Crockett (below) directs a crew that takes apart Ford and competitors' vehicles. Then he weighs each of the 12,000 to 15,000 parts, assigns catalogue numbers, and photographs them laid out on a three-inch grid. Any sudden change in weight of a competitor's new transmission, engine, or other major part calls for quick investigation.

Other engineering tests he supervises—before disassembly—include the ride and roll rate of each of the research cars, visibility, and a comparison of body dimensions. He helps in developing test procedures and equipment for the research staff; has to know how to use precision tools, read blueprints; and must check all work sheets before sending them to the engineers for help in designing future cars.

Crockett, who is now 32, went to work for Ford at 22. After finishing Henry Ford Junior College, he attended Wayne University. He has been in his present category, which pays from \$6,000 to \$9,000, for nine years. He lives in Garden City, Mich., a suburb of Dearborn, with his wife. A sports enthusiast, he golfs regularly, is a member of a ski club, and for one year managed a Ford baseball team.







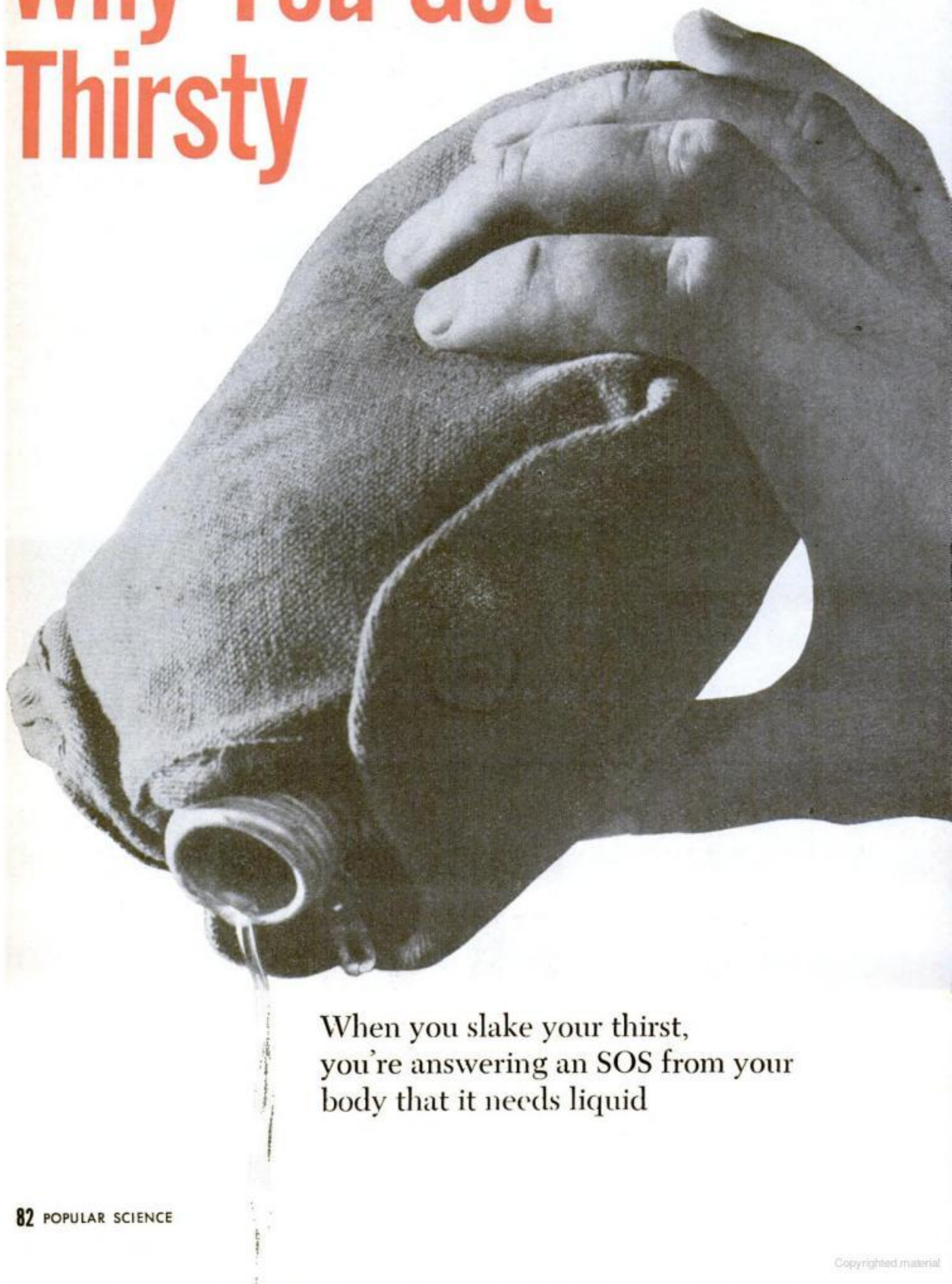
**Model-plane tester** Working with model planes is a man-size job for George W.D. Cook, head of the model shop at Georgia Institute of Technology's Guggenheim School of Aerospace Engineering in Atlanta. This calls for supervising the building and maintenance of some \$150,000 worth of equipment used by students and teachers. At one moment he may be overseeing the operation of mechanical shakers, which detect stresses on airplane-wing beams, or on rocket, boat, or submarine components. At the next, he may be directing modifications in models brought to Tech by aircraft and rocket companies for wind-tunnel tests (there are three tunnels, with a supersonic one soon to be built). He's shown above at a smoke tunnel, which demonstrates to students how air vortexes are set up over planes.

Under him in the shop are a model builder and a number of graduate students, but about 50 percent of the models are constructed at Georgia Tech's Engineering Experiment Station where he once worked in tool design.

Cook moved from Chicago to Atlanta at an early age, attended North Fulton High School there, and learned tool design at the Guggenheim School. During the war he was employed on artillery gun sights as a civilian, at one time was a gunsmith, and also made archery gear. Before heading the model shop he did tool designing for Tech's School of Mechanical Engineering as well as its Experiment Station. He earns around \$7,000 a year.



# Why You Get Thirsty



When you slake your thirst, you're answering an SOS from your body that it needs liquid



**A**TALL drink on a scorching day. That's the perfect picture of one of man's greatest physical pleasures: thirst quenching. A sensation as old as man himself, thirst is getting new and serious study by scientists today. Doctors want to know how to recognize its abnormal appearance in patients. Military leaders are concerned with the problems of survival, either in desert warfare, or in the event of a poisoned water supply.

Here are some of the questions they have been asking—and the answers:

### ***Does dryness in the mouth cause thirst?***

No. This was once the popular view, but physiologists now agree that thirst is a warning that the body's balance of water and salts (mainly sodium and potassium) is out of line. Minute changes in these ratios go on all the time inside cells, in the space between cells, and in the blood stream. If the scales balance too heavily on the salt side, the blood stream signals cells called "osmoreceptors." These trigger the sensation of thirst.

### ***What about induced thirst?***

Again your body's balance is off. This time not because you've lost water, but because you've eaten salty foods. (All those peanuts!)

Curiously, the body knows when it's water-hungry, but not when it needs more salt. Some animals, such as cattle and deer, do have a salt-craving mechanism. Humans don't. Fortunately a normal diet usually contains enough salt to make up for an occasional shortage.

### ***How does your body use water?***

Water keeps your body's chemicals in solution, making possible the necessary exchanges of nutrients and waste products. Water also helps lubricate your joints. And, as you perspire, it's the water evaporated from your skin that helps cool you off.

### ***What happens if you don't get enough water?***

You become dehydrated. If the shortage is severe, your kidneys suffer because there's not enough liquid to dilute the wastes they process.

In 1832, when a severe cholera epidemic struck London, an obscure physician named Lata made a significant discovery. An old woman was brought in on the verge of death. Everything had been tried on her, but to no avail. The doctor looked at her, doubting if she would remain alive long enough for him to get out his instruments. Then he began injecting salt and water into her blood stream.

By  
**Aaron Sittner**



*Too much salt makes you thirsty—upsets the body's balance. Hey, take it easy with those peanuts! Potato chips, too.*



*When you work on a hot day, you perspire. The water evaporates from your skin. You're cool, man.*



## How much water do you need? About three quarts a day. Your diet



*Suffering from dry, scratchy throat? Maybe it's too many cigarettes—or you may need a drink. Take a break. Head for the water cooler.*



*If you found yourself a nice cool spot, you could survive 8 or 10 days without water. You could live 30 or 40 without food (but it's a tough way to reduce).*

Slowly her pulse returned. In a half-hour, after six pints had been injected, she actually began to walk. Yet Lata's feat failed to create a stir in medical circles until the early 1900s, when cholera again hit London.

Today, this is one of the routine treatments in any situation where the body's water supply is depleted.

### ***Can a mild form of dehydration take place without triggering your thirst mechanism?***

Yes. If you smoke a lot you may assume that the dryness in your throat is natural. Actually, it may be a signal that you need more water. Also, if you chew gum often, your throat may feel nice and moist even when your system's out of whack.

### ***How much water do you need?***

About three quarts a day for an average adult. A normal diet will provide two-thirds of this. The rest must be taken in the form of drink.

### ***How long can you survive without drinking?***

Lying quietly in a cool area you could probably survive for 8 to 10 days. This is in marked contrast to fasting. You could live for 30 to 40 days without food—given enough water. On the other hand, if you eat, but have nothing to drink, death would probably come more quickly because water is necessary for metabolism.

Medical histories tell of an Italian political prisoner named Viterbi, who committed suicide by refusing to eat or drink. He died on the 18th day. In his diary he recorded that hunger pains ceased after the third day. But until the very end the "real tormentor" was his "burning thirst."

### ***How much water is there in your body?***

About two-thirds of your body's weight is in water. Some of it is in fluids, some in tissue matter. The muscles, for example, are about three-quarters water. The cortex of the brain has an even higher percentage of water.

### ***What should you do if you can't get water?***

Wartime survival manuals devoted much space to this problem. The reason was simple. Whatever hardships a man might face, dehydration was perhaps the gravest. Navy doctors studied the possibility of getting water by eating raw fish or even drinking sea water. But the salt



supplies two-thirds—the rest you have to make up with liquids

and protein matter in these required so much water for the body to process them that the gain was either negligible or canceled out. The best water source, these investigators found, would be the blood of birds—if they could be caught.

Castaways were advised to conserve their body's fluids by avoiding exertion and protecting themselves as best they could from the sun. Another suggestion was to sprinkle sea water on their skin to supply some of the moisture needed for evaporation. Otherwise, the body would have to provide it. Desert troops who might be lost were advised to lie quietly by day and walk only at night.

### ***How does temperature affect your body's need for water?***

The warmer the environment, the more water you need. At 82 degrees, a person doing hard work needs about seven pints of fluid a day. But at 94 degrees he'll need 13 pints.

The construction of Hoover Dam on the arid and sweltering Arizona-Nevada border was possible only because the construction workers were educated in desert living. They learned to take water and salt frequently, and to make maximum use of the shade. Living quarters were cooled for sleeping.

Yet even with these protective procedures the men often had to replenish their internal water supply by as much as 30 quarts a day.

### ***What happens when you drink too much water?***

You'll probably experience nausea. Other consequences may be diarrhea, tremor, or convulsions. Excessive water in your body will tend to wash away the vital salts in your system. So, rather than pumping yourself full of water, let your thirst be your guide.

### ***Does your body retain any of its water permanently?***

For years scientists wondered whether some of the fluids swishing about in the body would stay trapped somewhere in a cell or an organ. The answer was discovered in recent years by the use of "heavy water," a radioactive isotope of water that could be used as a tracer.

In 10 days, 50 percent of the tracer disappeared. In a few more days it disappeared completely. So it appears there is no fixed supply of water in your body. Like all the other streams and tides in nature, ours flows in, through, and away. ■ ■



*Navy doctors studied the possibility of getting water by eating raw fish. Report: negative.*



*Construction workers found it took about 30 quarts of water a day to keep 'em going in the desert heat. That's 7½ gallons. Pretty poor mileage.*





## Tanker middle crosses Atlantic

The squat ship's "midbody" at left has just completed an ocean voyage without either bow or stern. These were waiting for it in Bethlehem Steel's Hoboken, N.J., yard, where the tanker Raleigh had been cut in two to receive the 417-foot midsection and emerge as a 630-footer. The midbody is the second of four built by Schlieker Werft in Hamburg, West Germany, for Bethlehem, to "jumboize" old tankers. An ocean-going Dutch tug towed it across in five weeks.



Buzzards' annual return to Hinckley Ridge is . . .

### Calendar-conscious buzzards

The giant buzzards of Hinckley Ridge, Ohio, are becoming as famous as the swallows of Capistrano, Calif. Each March 15 the big vultures—among the largest known to naturalists—forsake their winter quarters in the Great Smokies to herald the return of

. . . met by telescopes, binoculars, and cameras.

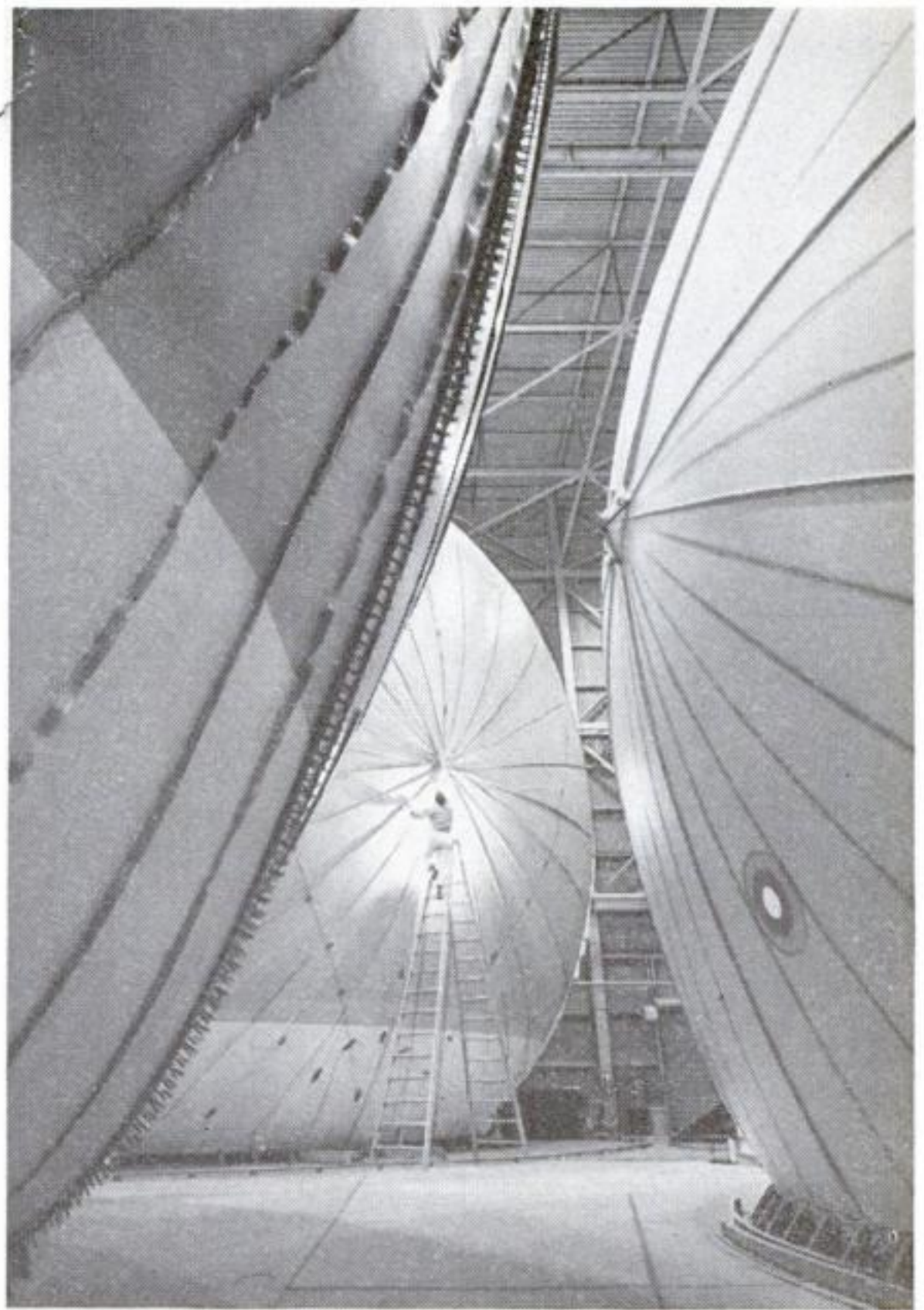
spring in the ridge area. Local historians say they have been doing it since before the white man settled the Cuyahoga River Valley. The annual return is celebrated the first Sunday in spring by thousands of natives and visitors (including ornithologists from many parts of the country) with a "Buzzard Breakfast" of hot cakes and coffee.





### Goggles give pigeon an owl-eyed look

Because pigeons can distinguish color, scientists think their eyesight may be much like that of man. To find out, the lensless goggles this bird is wearing were devised at the University of Maryland. Made of short lengths of aluminum tubing, they were cut diagonally to fit the sharp contour of its face, then fastened on with collodion. The goggles will act as blinders during tests.



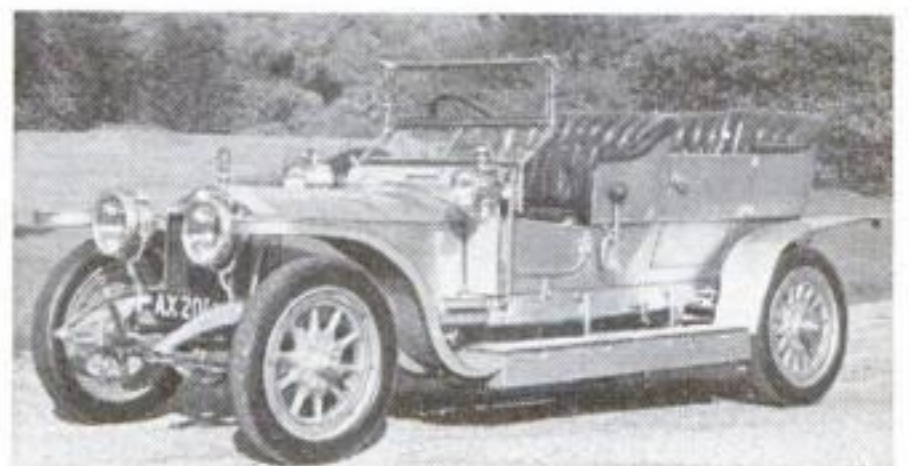
### Mobile radar antennas blow up like balloons

The 30- and 50-foot-diameter balloons above are strung with foil and wires for use by the Air Force as radar antennas. Deflated, they can be transported by truck and put into service almost immediately simply by unpacking and inflating wherever they are needed.

Westinghouse is experimenting with them also for use in space as radar, radio, and TV antennas and as solar-energy collectors. They would be sent up deflated in missiles, then self-inflated when they went into orbit.

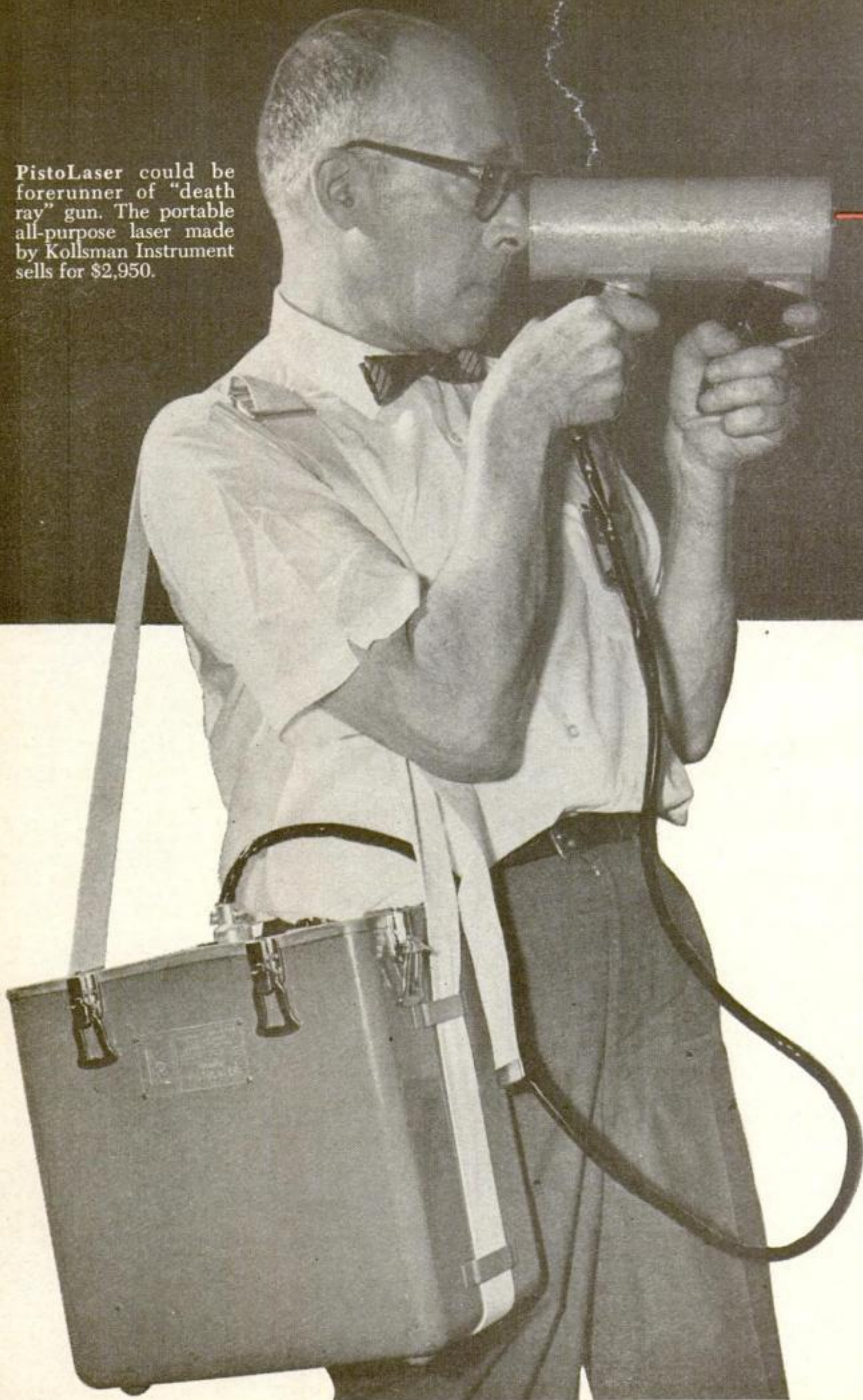
### 1906 Rolls still rolls

This Rolls-Royce, a 1906 Silver Ghost with 400,000 miles on its clock, recently repeated its record run of 50 years ago—a 400-mile drive from London to Edinburgh. The 48-hp. car was named for its silver-plated trim and its silence. An expansion chamber on each of its six cylinders gives it its wraithlike quiet. The original owner willed it to the company.





PistoLaser could be forerunner of "death ray" gun. The portable all-purpose laser made by Kollsman Instrument sells for \$2,950.





A flash of red light jolted from a ruby cuts metal and tissue, transmits TV shows—and may knock out missiles

# The Incredible Ruby Ray

By C. P. Gilmore

**I**N A laboratory in Schenectady, N.Y., a scientist touches a button and a piercing bolt of weird red brilliance leaps from the end of a flashlight-size tube, slams into a diamond. Blue-white flame jets from the ultrahard stone with a crackle like a pistol shot as the surface heats to 10,000 degrees F.—hotter than the surface of the sun. One five-thousandth of a second later, a hole smokes where the ray struck.

In a New York hospital, a surgeon directs a delicately controlled version of the ruby ray into a patient's eye. In 1/1,000 of a second, a tiny tumor deep within the eye disappears.

Elsewhere, researchers are using the ruby ray to build an optical variety of radar far more accurate than the best conventional models, a radiolike communications system capable of carrying more information than any system now operating, and a speedometer to allow space ships to rendezvous in orbit with hardly a bump. Most significant, they

are designing a weapon that could be the long-sought defense against missiles.

At the heart of these science-fiction gadgets is a *laser*—an electronic flashlight that generates a powerful new kind of light. The laser's beam is as different from ordinary light—the kind we get from light bulbs, matches, the sun—as a Cadillac is from a kart. Its uncanny properties make it ideally suited for a strange collection of complex jobs. For example:

- A super-powered version of the la-

CONTINUED

**Radar that uses light:** Laser beam sent out at left hits target and bounces back to a telescope mirror. The Colidar, developed by Hughes Aircraft, can pinpoint objects seven miles away.





# Map the moon, signal subs, steer satellites? Done—in the wink

ser's electronic lightning may burn holes in attacking missiles, turn them into flying scrap metal. All three branches of the armed forces are staying up nights working on this one.

- The laser's light will map the moon. MIT scientists bounced a laser ray off the moon's surface, found that it could be focused so sharply that it covered a spot just two miles in diameter. Conventional radar fans out bigger than the moon itself, can't distinguish individual features.

- The ruby ray may open vast new realms of the spectrum—far larger than all bands presently used for radio, TV, the works. Just one laser beam can easily carry 25,000 simultaneous television programs.

- The laser's glow will cauterize wounds, communicate between submerged submarines, transmit power without wires, and push satellites around in orbit.

*It looks so simple.* Deceptively so. The laser's heart is most commonly an unremarkable synthetic ruby about two inches long and as big around as a pencil. Surrounding it is a bright light—

usually a high-intensity flash tube similar to a photographer's strobe lamp. Send a jolt of electricity through the flash tube and a laser beam leaps from one end of the ruby. Supply a continuous light and the laser beam shines steadily.

That's all there is to it.

The trick lies in the fact that the ruby atoms, excited in the proper way, produce a very special kind of light. It is coherent: The light waves, unlike those in ordinary light, are all in step.

You can see what's involved if you think of water waves. Suppose you pitch a handful of pebbles into a pond. Each pebble sets up its own ripples. The pond is covered with a jumble of wavelets traveling in all directions. Regular light is like that. But suppose you drop in a single stone. Then smooth ripples spread out evenly from the center. That's coherent light.

All light—until the laser came along—was incoherent. Ordinary light contains rays of different colors (corresponding to different frequencies), which act like the ripples from the handful of pebbles.

Radio waves, on the other hand, are

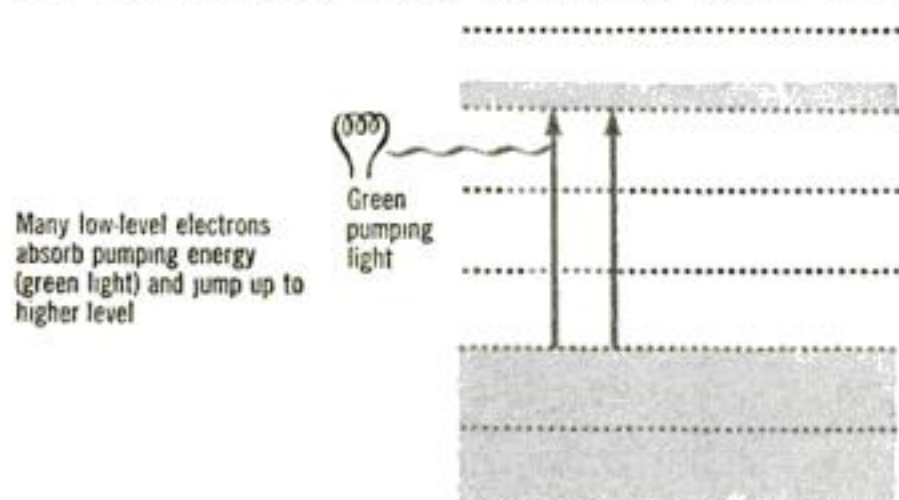
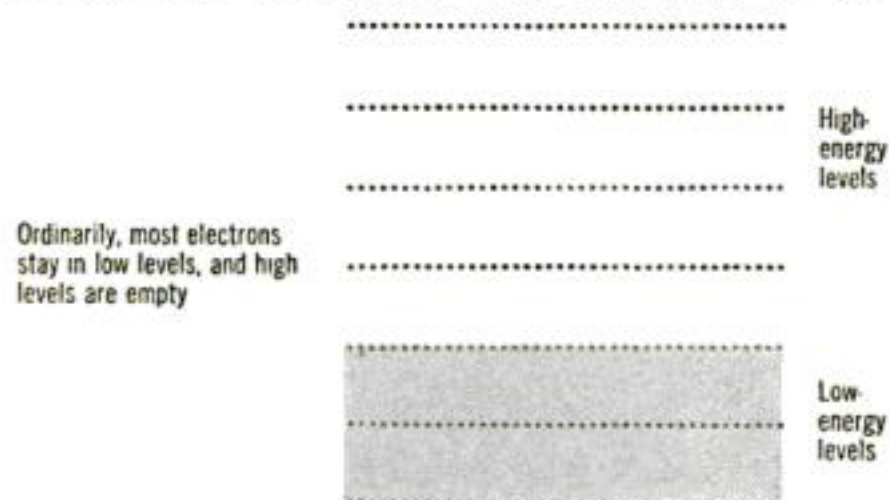
## Here's How the Laser Works

Electrons may exist in any one of several energy states or "levels." Any electron can absorb energy from the outside and jump to another higher energy level. But at this high-energy level it's like a wound-up spring. It wants to unwind—fall back to its normal low level. In the process of falling back, it releases the stored energy.

Most lasers are made of artificial ruby—crystalline aluminum oxide with a small percentage of chromium. The electrons in the

chromium atoms can be "pumped" to a high-energy level by hitting them with intense light. In millionths of a second, they fall back to the lower energy level, and release light of their own. Normally, though, this light is incoherent—mixed up. The atom returns to the low-energy state at random, giving off a red glow. The trick is to get all the electrons to release their stored up energy in step. Here's how it's done.

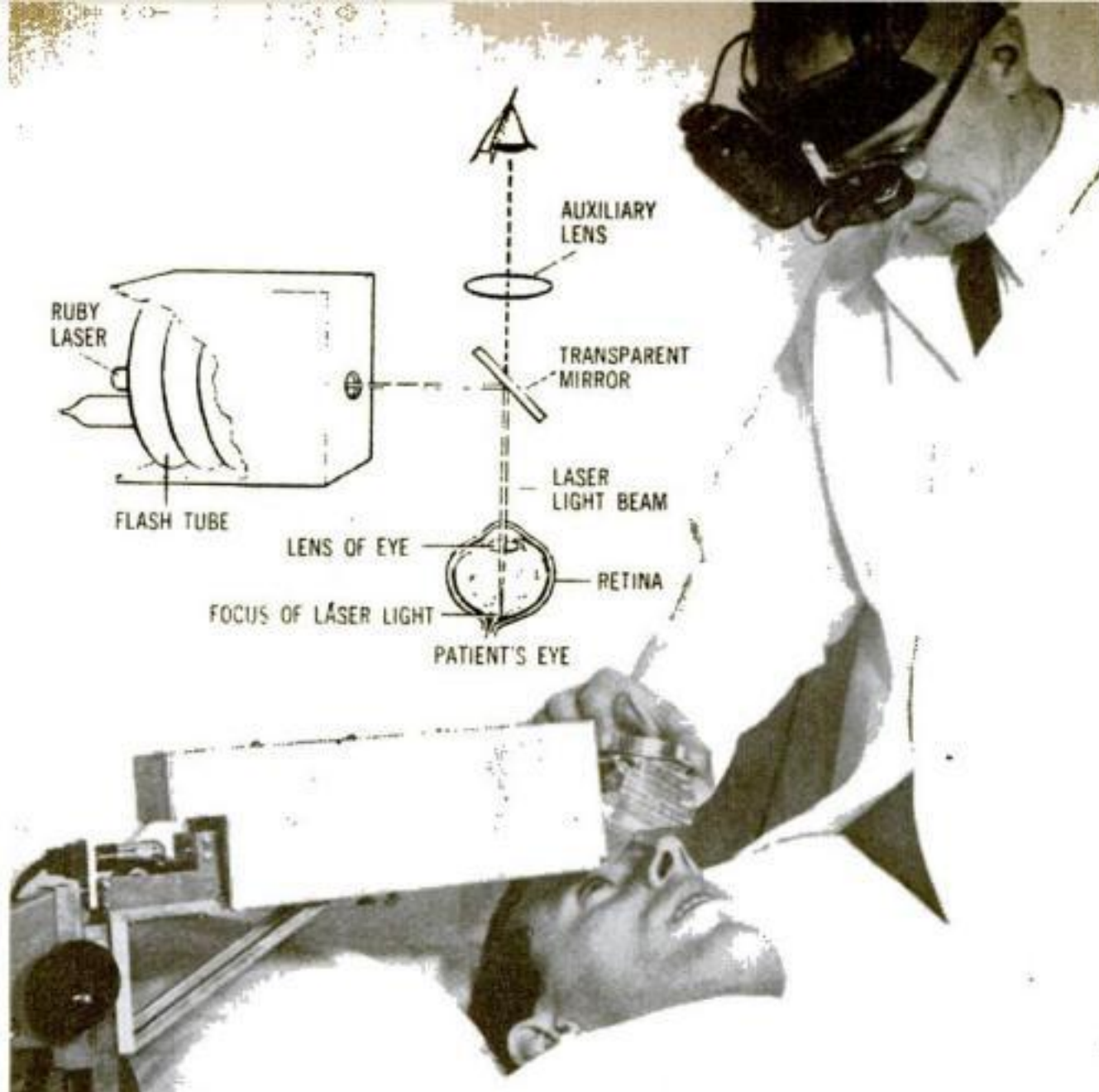
The ruby is cut into a cylinder about a quarter-inch in diameter and from two to eight inches long. The ends are silvered, so that light can be reflected back and forth down the





## of a laser's eye

**Painless eye operation** to remove a tumor from the retina was performed at New York's Columbia Presbyterian Hospital with this American Optical Co. laser. The tumor was burned with a beam of coherent light focused as shown in the diagram. Operation takes  $1/1,000$  of a second. Similar set-ups have been used to spot-weld detached retinas in laboratory experiments with rabbits.



coherent. A transmitter generates just one frequency, which spreads like the ripples from a single stone. Because it is coherent, you can modulate it—load it with a voice, telegraph, and television signals at the transmitting end, then unload them at the receiving end.

**Hash and coherence.** A regular light beam—from a searchlight, for example—

cannot be modulated like a radio wave because of its incoherence. It would be like trying to stick signals on a wave so full of noise that the voice would be drowned out.

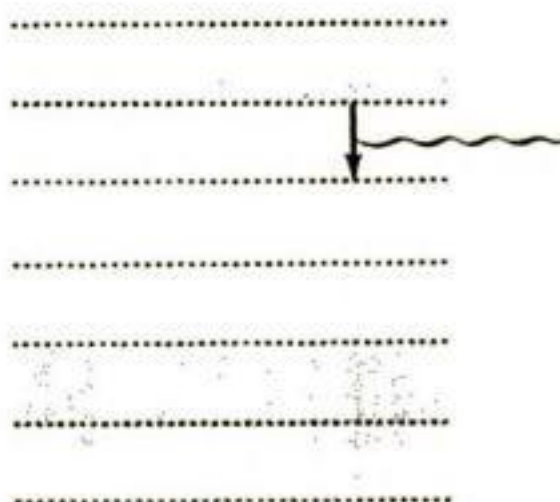
With a coherent light source you can transmit radiolike signals. But there's one big difference. The amount of information a wave—radio or light—can

cylinder's length. Then the chromium atoms are hit with a tremendous burst of light. A large number of electrons are pumped to the high-energy level, and some begin falling back to the lower level immediately. Some of this light released by the electrons strikes other high-energy electrons, triggering them to radiate their energy, too. Fortunately, they release it exactly in step—in phase, engineers call it—with the light that set it off. This reinforced energy now hits more electrons at the high-energy level, triggering them to give up more in-phase energy.

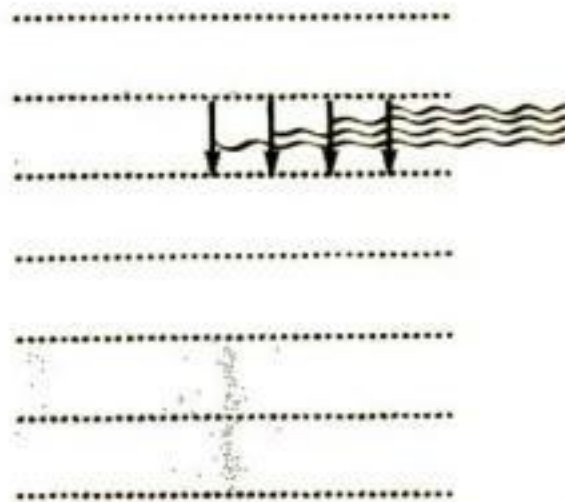
Within a few millionths of a second, huge pulses of radiated energy are rushing from one end of the cylinder to the other, like water sloshing back and forth in a bathtub. Finally, the signal gets so strong that it bursts forth from one end of the crystal (an end only partially silvered for just this purpose). What you see is a tremendous burst of eye-dazzling coherent light.

In continuously operating masers, the pumping light lifts low-energy electrons to the high-energy state as fast as they fall back in the lasing action.

A few pumped-up electrons jump down to next lower level, releasing energy (red light). This released energy stimulates more electrons to jump down



Repeated release of red-light energy builds up until tremendous number of electrons jump down—all in step—giving off powerful flash of coherent red light



CONTINUED



transmit depends on its frequency. Because of its extremely high frequency, a single laser beam can carry more information than all radio and television channels now in use put together.

A single laser-equipped communications satellite over the Atlantic Ocean could transmit hundreds of times more messages than all undersea cables now in existence combined—and a few thousand television programs to boot.

Coherence allows laser beams to be focused into far narrower rays than either radio or ordinary light. The super-sharp beam, a natural for such jobs as moon mapping, has scores of applications. An orbiting space ship, for example, could point its laser communications beam at the ground station and send messages in complete privacy. Unless you're directly in the beam, you can't intercept or jam the message.

Simple and tight focusing means that lasers will be far lighter and more compact than the radios and radars they replace. A prototype laser radar built by Sperry Rand, for example, weighs about 25 pounds complete and looks like a telescope three feet long. It can distinguish two cars parked side by side five miles away. Later models may pick out baby carriages at the same distance. A comparable conventional radar would have to be carried around in a truck.

With the right lenses, the sharp laser beam can slam its entire power into a pinpoint. This technique concentrates the beam for eye surgery. Heat developed by high-powered models slices easily through diamonds, stainless steel, and other tough materials.

**Concentrated heat.** This extreme concentration of intense heat is what the military is counting on to serve as an antimissile weapon. Although the project is top secret, some information has filtered through. Dr. M. L. Stitch of Hughes Aircraft reported last year on a laser that delivers 600,000 watts. Later he mentioned "remarkable advances" without giving any more figures.

Air Force General Curtis LeMay, in a speech last March, spoke of "beam-di-

rected energy weapons." The Army hired American Optical Co. and Quantatron, Inc., to work on "high-energy radiation devices." The Office of Naval Research asked for a study of similar weapons.

Such a weapon would have as much impact on military tactics—and world politics—as did the atomic bomb. A laser missile killer could skitter around the sky literally at the speed of light. No need even to tell the decoys from the loaded missiles—just blast them all. You don't have to burn up the whole missile with the beam—damage its guidance mechanism a little, and it will burn itself up on re-entry.

The armed forces aren't overlooking the possibilities of using lasers to knock out tanks, trucks, and foot soldiers. Several companies have under development a gadget that could be that oldest of science-fiction devices, the death ray.

**How it all started.** The laser's possibilities began to excite scientists even before there was such a thing. In 1954, Dr. C. W. Townes, then of Columbia University, thought of a new way to build an amplifier: "Pump" atoms to an excited, high-energy state by bombarding them with microwave power. Each atom would store up extra energy—like a wound-up spring. Then feed an incoming signal—the low-powered wave to be amplified—to the excited atoms. If everything worked, the low-powered signal would jolt the atoms into giving off their stored energy in a burst. A small signal input would kick off a large output.

Townes named his contraption the **MASER**—Microwave Amplification by Stimulated Emission of Radiation. Then he wondered: Why couldn't a maser operate at such a high frequency that its output would be, not radio waves, but pure light? Scientists all over the country set out to build such a device.

Dr. T. H. Maiman, then at Hughes Aircraft, was the first to make a light maser, or *laser*, work. But scientists at Bell Labs were right on his heels, and now hundreds of companies have en-

[Continued on page 200]





# My Best Photos for PS

An old pro picks his favorites  
from the ones that made "Photos  
by W. W. Morris" famous



"That's me, Bill Morris, at top, Medalist II in hand (though usually I'm clutching a Rollei), photographing Greenland's Moltke Glacier from a helicopter. A PS staff writer snapped me. Upper photo, 1/100 at  $f/8$  on Super XX film, K2 filter. Glacier photo, 1/250 at  $f/11$ , Aero 1 filter, same film. This was hairy—survival time in case of a dunking is about five minutes."

CONTINUED





"The size of this iceberg is shown by the Coast Guard icebreaker East Wind. The photo was taken

**By Devon Francis**

**A** BIG, lumpy, white-haired guy with a passion for taking good pictures will retire this fall from POPULAR SCIENCE. He is William Worth Morris. A number of men named Wil-

liam have worked for this magazine during Morris' 22 years on the payroll, but there has been only one Bill, chief of the photo department.

The other day it was suggested that some of the best of the Morris photographs, made during those two decades





from a small motor launch. I shot at 1/250 at *f*/11 with an 'A' red filter on Super XX."

and more, be reproduced for the readers of this magazine.

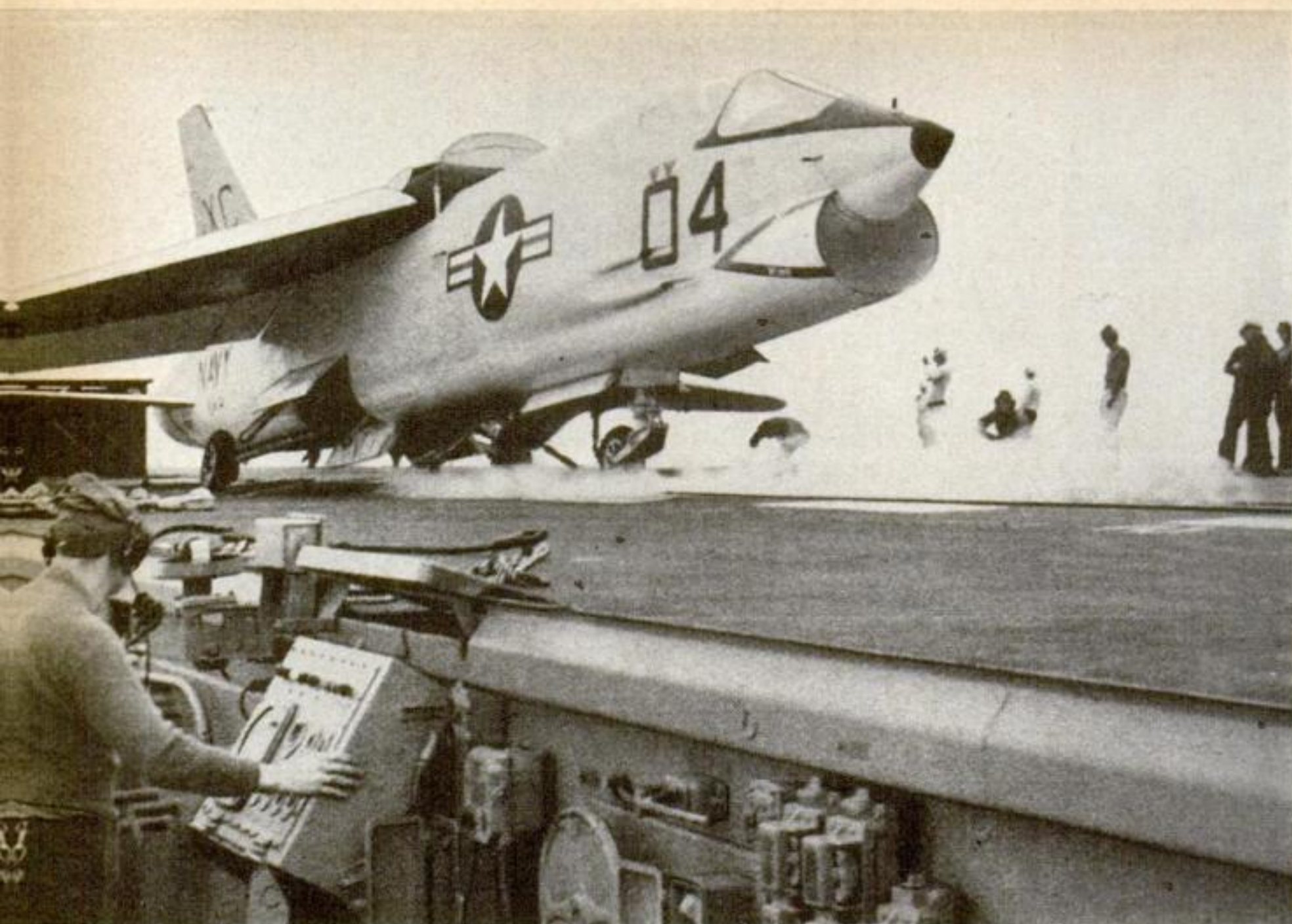
"Aw, what for?" grumbled Bill Morris.

It was a characteristic response. Nonetheless, the photographs, with captions in his own words, are reprinted on these pages. We trapped him into it.

Bill Morris has roamed the world on picture assignments—Europe, the Orient, the Arctic. He has snapped his shutter on things as small as the head of a pin, as gigantic as an iceberg. Clutching his precious cameras, he has worked under the canopy of a 600-mile-an-hour atomic

[Turn the page for more pictures; [text continued on page 222](#)]





"Here's an F8U jet, straining to go, on catapult of carrier Roosevelt, shot at 1/500, f/16, on Tri-X."



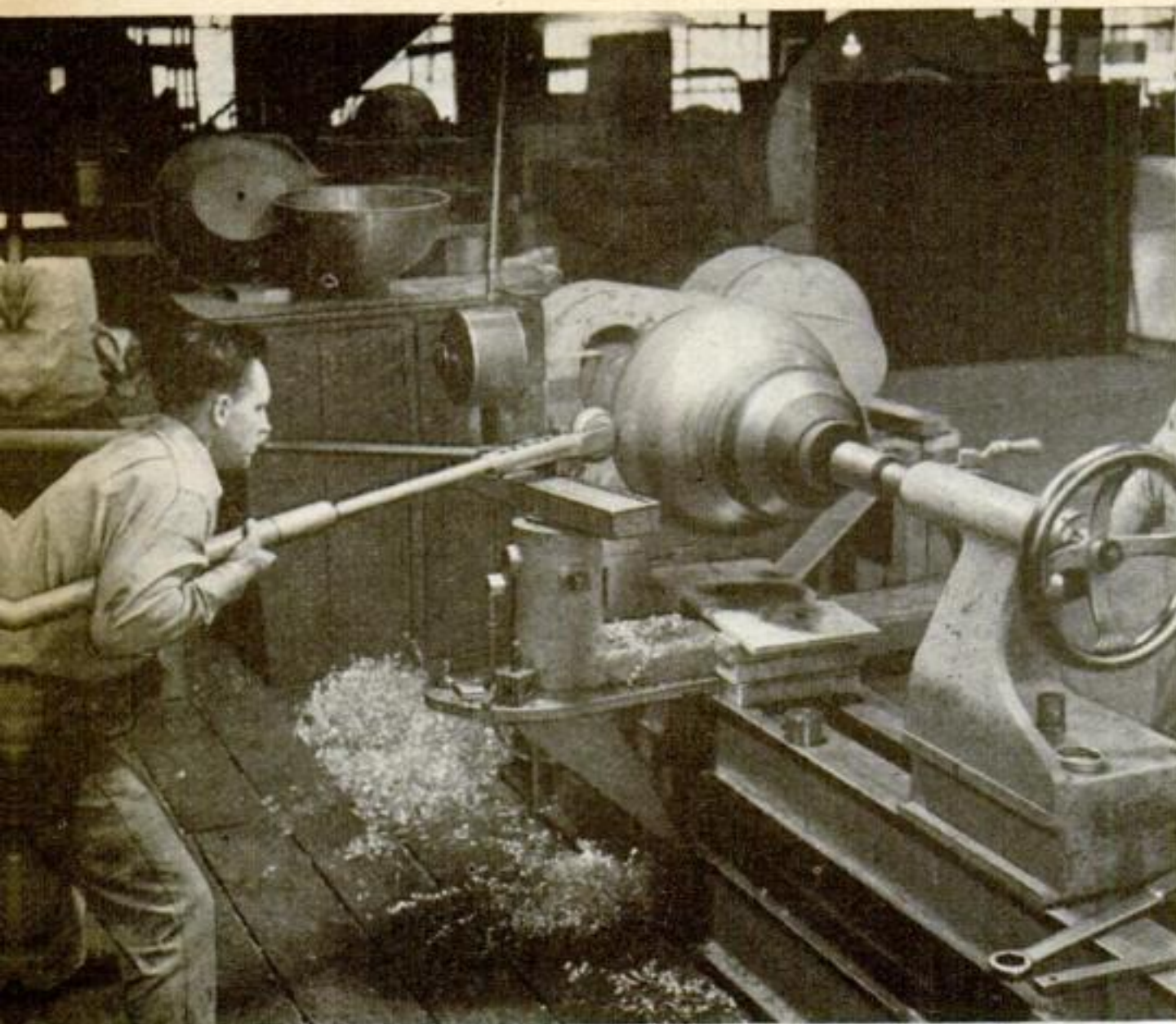
"The dog (left) was photographed at Bitburg, Germany, where a pack of Air Force K-9s had been trained to guard our F-100 fighter-plane base. The lighting was ideal, with reflections from concrete. I shot at 1/250, f/22, on Tri-X."

"The plastic balloon (right) on the deck of the Navy icebreaker Atka in Davis Strait, off Greenland, ascended to about 80,000 feet, then launched a rocket carrying scientific instruments to an altitude of 350,000 feet. I shot at 1/125, f/8, on Super XX film."



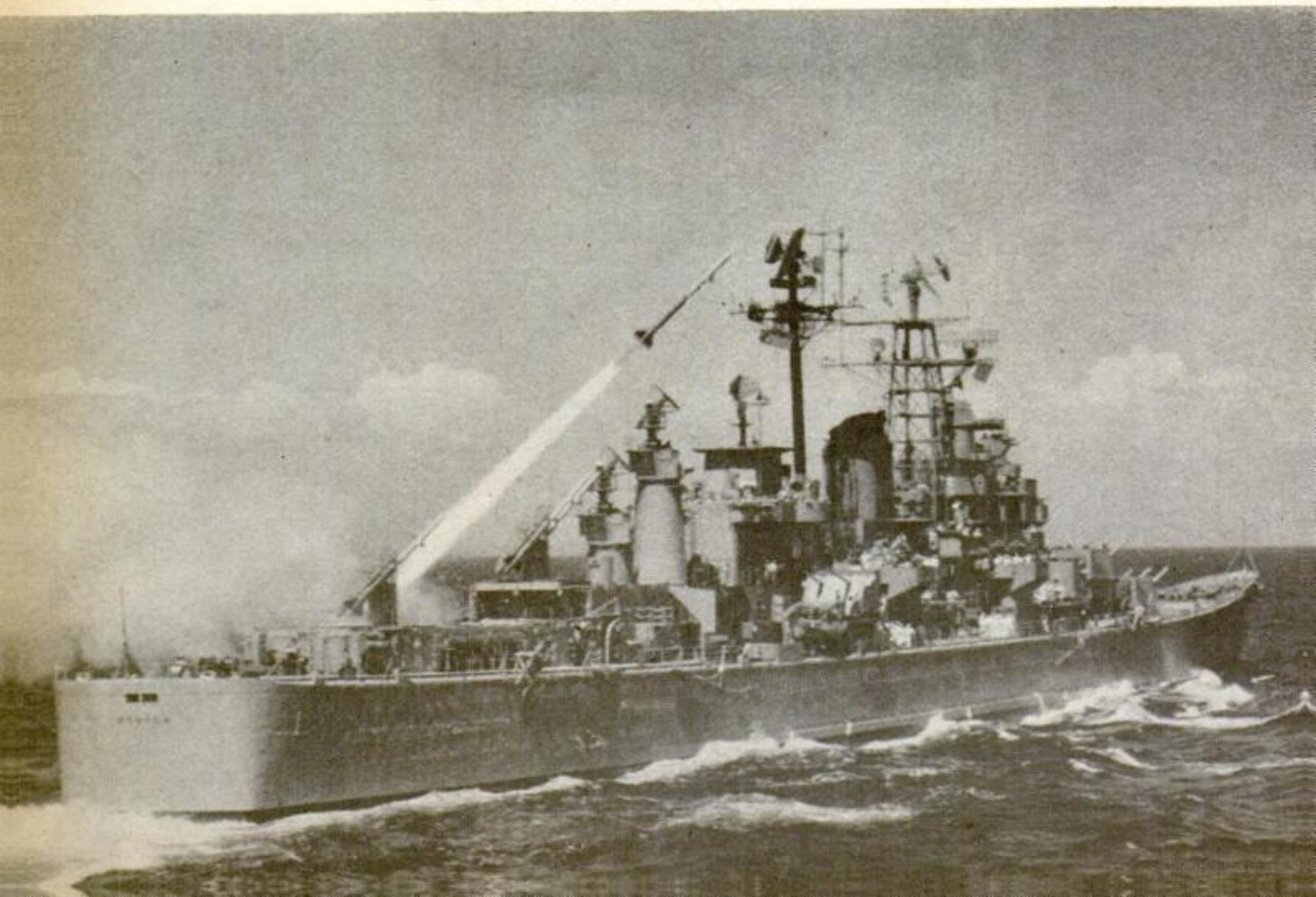






"Industrial photography is tricky. I needed good light around this spinning lathe and a sense of movement. I used three 200-watt-second strobes, a 500-watt light overhead. 1/30, f/11, Tri-X."

"From the bridge of a destroyer, I shot the first guided missile ever fired at a remote-controlled drone. A 'Terrier,' riding a radar beam from the missile cruiser USS Boston, it scored a direct hit. The light was intense: I used a K2 filter at 1/500, f/16, on Tri-X."





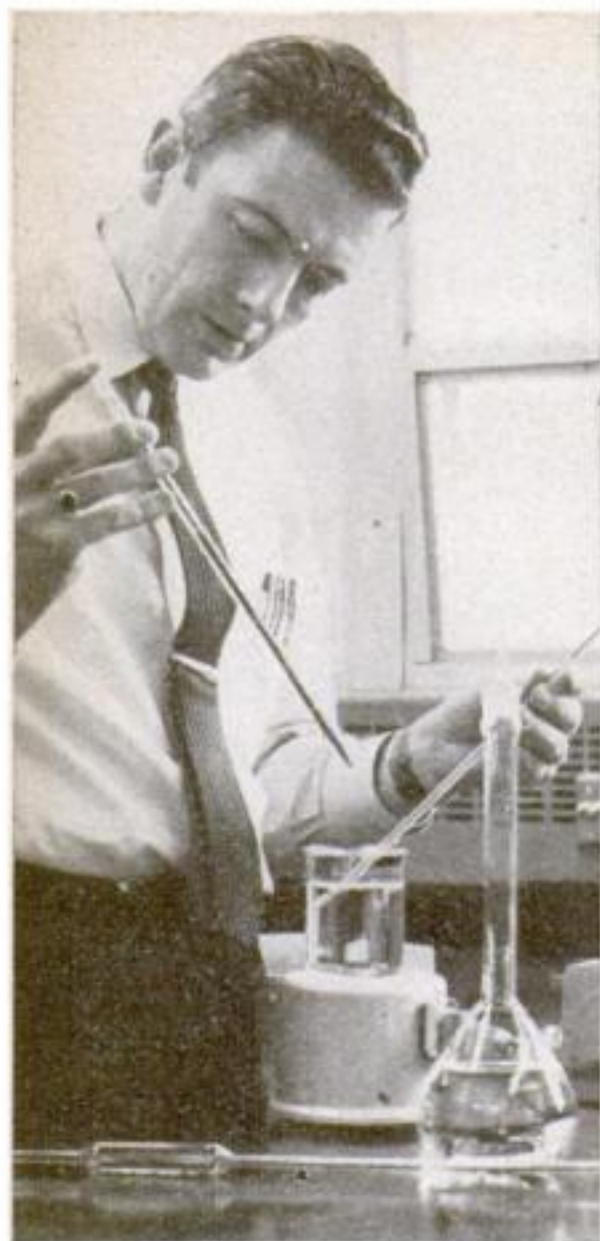


"This is what a B-52 bomber looks like when it's 'on the hook'—the refueling boom of a tanker plane. I shot from the boom operator's platform on the tanker. It was almost an against-the-light job. Needing a wide-angle lens, I used a Hasselblad with an Aero 1 filter, 1/250, f/11, Tri-X."



"Paradivers are part of the Mercury Astronaut space program. I photographed these two (one is in the water at right) as they practiced putting an inflated collar around a capsule, after having parachuted down. Their motto is: 'We get there fastest, dive deepest, stay down longest.' Exposure: 1/250 at f/16, with K2 filter, on Tri-X."





**Dr. Frank B. Salisbury** has been speculating on life on or off the earth for a good share of his 36 years. As a boy he worked as a naturalist in camps near his home town of Salt Lake City, Utah. As a Caltech graduate student he began tackling problems in astronomy from a botanist's viewpoint, producing a number of papers.

A professor of plant physiology at Colorado State University, he has been running three research projects. One is on flowering and the "biological clocks" of plants (their inner timing mechanism); one on alpine plants (Martian prototypes?); and one on space biology (his verdict on a space traveler's ability to live on algae: "It'll never work!").

Currently he has packed himself and family (wife and four children) off to the University of Tübingen, Germany, for a year's research in his favorite subject: biological clocks. He says, "Solve the mystery of when and why a gene suddenly comes to life and starts a plant flowering, and you will have cracked one of the fundamental problems in biology."

# WHY I BELIEVE THERE IS LIFE ON MARS

A botanist who's an expert on the clever tricks of Earth plants speculates that Martian flora may be even smarter

An interview with **Dr. Frank B. Salisbury** by Joan Steen

**"E**VERYTHING points to it—and not just 'low life' like algae or mosses—but really developed higher plants.

"It could be a sea of fern, tall as Iowa corn but supple like wheat. Or something broad-leaved and brown like cured tobacco. More likely it's something so fiendishly adapted to Mars that it won't be like anything on Earth . . ."

Dr. Frank B. Salisbury enjoyed speculating. The handsome botanist rocked back on the heels of his chair, hands clasped behind his head.

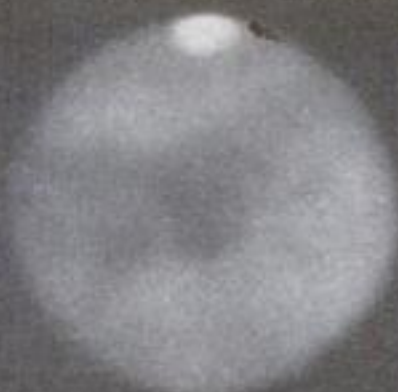
"And once you have higher forms," he went on, "there's no reason you can't have animals to eat them. And if animals, why not intelligence in some form or other? After all *something* has to account for those satellites."

"What satellites?" I asked.





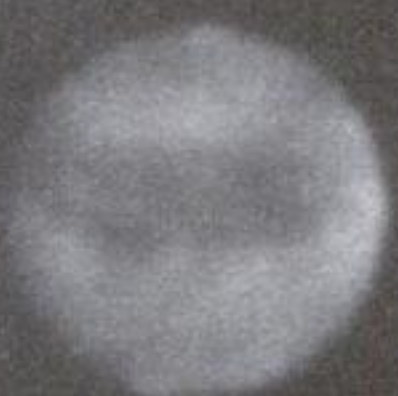
March 9



June 23



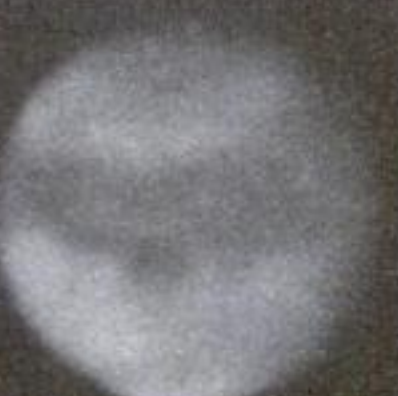
May 11



July 31



May 29



August 21

## Spring on Mars brings striking signs of life

Mars changes color during its six-month spring. The pale blue-gray areas darken. Some become brown or black; others, red or even moss green. The changes appear linked to what's happening at the Pole. The South Pole white cap (top of photos) starts to shrink in March, and the color darkening spreads out from there until it reaches a peak in regions around the equator in mid-August. Some observers believe the cap is frost that melts and starts a return of life to the planet.

Astronomers are more interested in Mars' southern hemisphere because summers are hotter there—hence more likely to support life.

The South Pole appears at the top because of the telescope's inverted image. All photos show the same face of Mars.—*Lowell Observatory.*

*\*Dates reckoned according to Martian year*

"Mars has two satellites: Phobos and Deimos," he said. "They're both small and they orbit Mars very closely. Phobos, in particular. The way it accelerates during part of its orbit is best explained by assuming it's hollow." He paused. "And naturally formed moons don't come that way.

"Not only that," he went on while I sat staring, "nobody could spot them in 1862—the best year for viewing Mars in the 19th century. They showed up for the first time 15 years later."

"You mean there could be intelligent beings on Mars who launched artificial satellites?"

"Could be," Salisbury said. "Of course the idea is pretty far out. I'd settle for reasonably clever plant life."

"Yes, let's get back to your everything-points-to-it statement."



Are the canals real? The late Percival Lowell thought so and sketched them on a globe. He assumed they were channels that carried polar snow-melt to all parts of the planet.





"A jungle of big, slender, stalky, flood-fed plants": That's how H. G. Wells described Martians and W. R. Leigh drew them in 1908.

"Sure," he said, and the chair dropped forward on the floor as if it had been called to attention. "The main reason I think there are plants on Mars is the seasonal change in the surface markings."

*The changing seasons.* "When it's spring in the southern hemisphere the

white cap around the South Pole begins to disappear and another one forms up north. Observing over a period of months you see a pattern of rich, dark colors spread out until it reaches a peak in triangular-shaped shadowy areas around the equator.

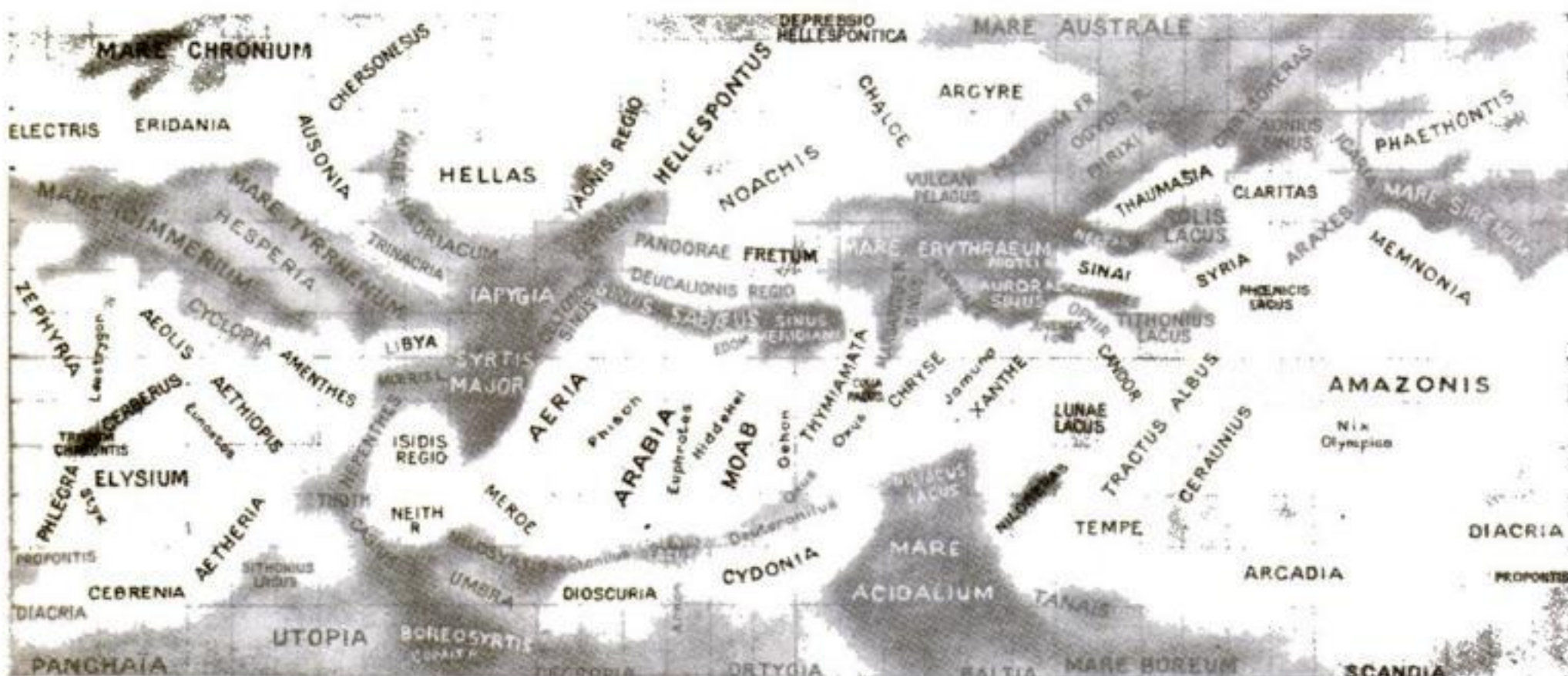
"Oddly enough, the colors don't go from ice-blues to greens, but from pastels to dark browns, tinged with red. Occasionally you do see green, but the brown is more common." He paused again.

"The other striking evidence comes from spectrum analysis. We know that every chemical compound or element reflects light in a distinct way. When the light gets separated-out in a spectrum, a unique pattern of bands shows up. Lately William M. Sinton at the Lowell Observatory in Flagstaff, Ariz., has spotted bands that suggest carbon compounds. And in the dark areas only.

"That's exciting. Sinton's bands are the only positive sign we have that suggests life—or at least the kind of complex organized molecules that make up life as we know it on Earth. We probably won't know more until we start orbiting telescopes or land a space probe on Mars."

"But that could be in the next few years, couldn't it?"

"Right. That's why there's so much interest in Mars right now. Frankly I



Early map makers thought Mars' dark areas were seas, hence the Latin word *mare* persists in place names. Dark triangle left of center

and halfway down is *Syrtis Major*—Prof. Salisbury's "Africa" of Mars. Map is official one adopted by International Astronomical Union.



## What We Do Know About Mars . . . And What We Don't Know

Its distance from the sun: 141,690,000 miles (avg.)  
 Period of revolution (year): 687 days  
 Period of rotation (day): 24 hours, 37 minutes  
 Diameter: 4,200 miles (about half of Earth's)  
 Surface gravity: 38% of Earth's  
 Surface pressure: 10% of Earth's

It has an atmosphere—probably rich in nitrogen and carbon dioxide . . . . . But we don't know if there is any water vapor or oxygen

And clouds { white ones . . . . . Like Earth clouds?  
 { yellow ones . . . . . Iron oxide dust? Or a nitrogen compound?

It has white caps at its Poles . . . . . Frost?  
 And colors that change during the year . . . . . Signs of vegetation?  
 And curious markings: the "canals" . . . . . Imaginary? Or made by intelligent beings?

And Satellites { Phobos—4,000 miles above Mars } . . . . . Are they artificial?  
 { Deimos—13,000 miles above Mars } . . . . . Launched by an advanced civilization?

Is there life?

wouldn't mind making the trip myself."

"Hmmm," I said. "I guess present telescope photographs and spectrographs—no matter how good—aren't conclusive."

"I'm afraid not," he agreed. "You can usually see Mars better just watching with a telescope instead of filming it. The earth's atmosphere is so wobbly that the time exposures come out blurred."

"Same thing applies to spectrographs," he continued. "The atmosphere's a nuisance, but for other reasons. We can't tell how much water vapor or oxygen there is on Mars—we suspect very little—because there's so much in our air."

**Martian weather.** "Can you describe what you expect to find once we land there? What's the weather like?"

"Cold, of course. It's that much farther from the sun. An average for the whole planet might be 40 below, as compared with 60 above for Earth. But averages are foolish. It depends where we land and at what time of day—or year. Around the tropics it can get up to 70 or 80 degrees during a summer day (but dip 100 degrees below freezing at night)."

"Okay. Suppose we drop down some place near the equator at high noon on a summer day. What would we see?"

Salisbury beamed and leaned back,

half closing his eyes. "Let's say we land at Syrtis Major. That's the place I'd like most to see. It's sort of the Africa of Mars—the largest, lushest-looking of the dark triangles, roughly the size of Mexico."

He got up. "Want to see it? There's a map around some place." He went to the filing cabinet. Somewhere between *Macrospores* and *Morning Glories* there was a thick Manila folder, *Mars*.

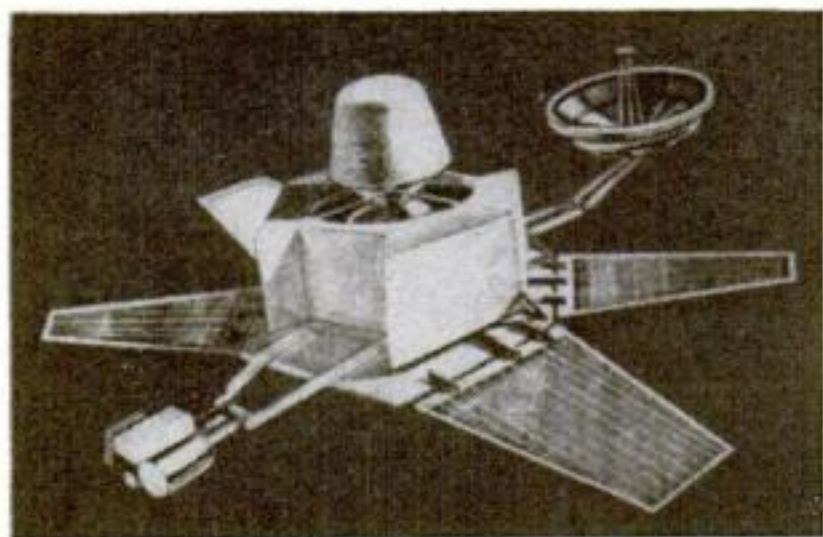
He took out a map and put his finger on Syrtis. "We won't land on Syrtis itself, but on its edge." He settled back in the chair again. "We are still in the spaceship looking out. The sky is a kind of hazy bluish white. We don't see the sun distinctly; the Martian atmosphere contains particles that scatter the light—especially toward the blue end of the spectrum. They could be ice crystals."

**A mysterious cloud.** "The terrain is flat. (There is no evidence of shadows that volcanoes or mountains might cast.) There may be some white Earthlike clouds overhead. Toward the horizon there's a menacing sight: a massive yellow cloud swirling up 10 or 15 miles. Sometimes clouds like that storm over the whole planet and color it yellow."

"What are they?" I asked.

"Maybe gas. More likely dust—blown





## Life Detector May Land on Mars in 1965

That "thimble" capping the Mariner B spacecraft in the sketch may be the first feeler for life on Mars. NASA plans to drop the cap on the planet by 1965. A sticky string extended from it along Mars' surface would try to pick up microorganisms and seal them inside the thimble to grow on a radioactive broth. A Geiger counter could measure the growth rate—if any—and telemeter results back to Earth.

up from the desert area where we are."

"Desert?" I asked. "You mean dunes?"

"Well, as you know, Mars generally looks orange-red—even without a telescope. Many observers think the planet is covered with reddish iron oxide dusts—rusty deserts."

"Not very inviting, I must say. Let's get to the markings. Are maps like this one fairly standard?"

"The shapes vary a little from year to year. Sometimes a new marking shows up, or an old one disappears. But Syrtis, for example, has been mapped consistently for 100 years."

"Now you're making me restless. Let's get out of this spaceship and move there. What's the atmosphere smell like?"

"I don't know," Salisbury grinned. "If I step out of my space suit I'm dead!" We both laughed.

"Seriously," he added, "you have to carry your oxygen with you, and you need a pressurized suit. At Mars' low pressure—10 percent of Earth's—your blood would boil."

"I'm sorry I asked," I said.

"Okay. Now let's have a look at Syrtis. But I warn you that what I see will be sharply different from what many astronomers expect. There are half a dozen physical theories that attempt to explain the changes on Mars in nonliving ways."

"But you think they're wrong?"

"Yes. Of course for every argument there's a counterargument, even mine. I just think it's easier to defend life."

"Fine. Start defending."

"We've said already that the color

change fits neatly into a spring-summer vegetation cycle.

"A second point in favor of life is that when the yellow clouds do cover the planet they don't permanently tinge the markings yellow. Within a couple of weeks, whatever is there shakes it off or grows up through the cover. You can't do that unless you're tough—and tall.

"That, for my money, rules out lichens. They've often been proposed as the kind of life you might see on Mars, mostly because we know lichens can survive the worst extremes of Earth temperatures.

"But I'm against lichens—not only because they're flat. They also take a heck of a long time to achieve anything like a widespread cover; they need lots of water to grow much; and they don't change color. Finally, a lichen can only exist if there are algae and fungi. If Mars has lichens it'd probably be easier to detect the stuff they depend on first."

"Okay. No lichens. What else then?"

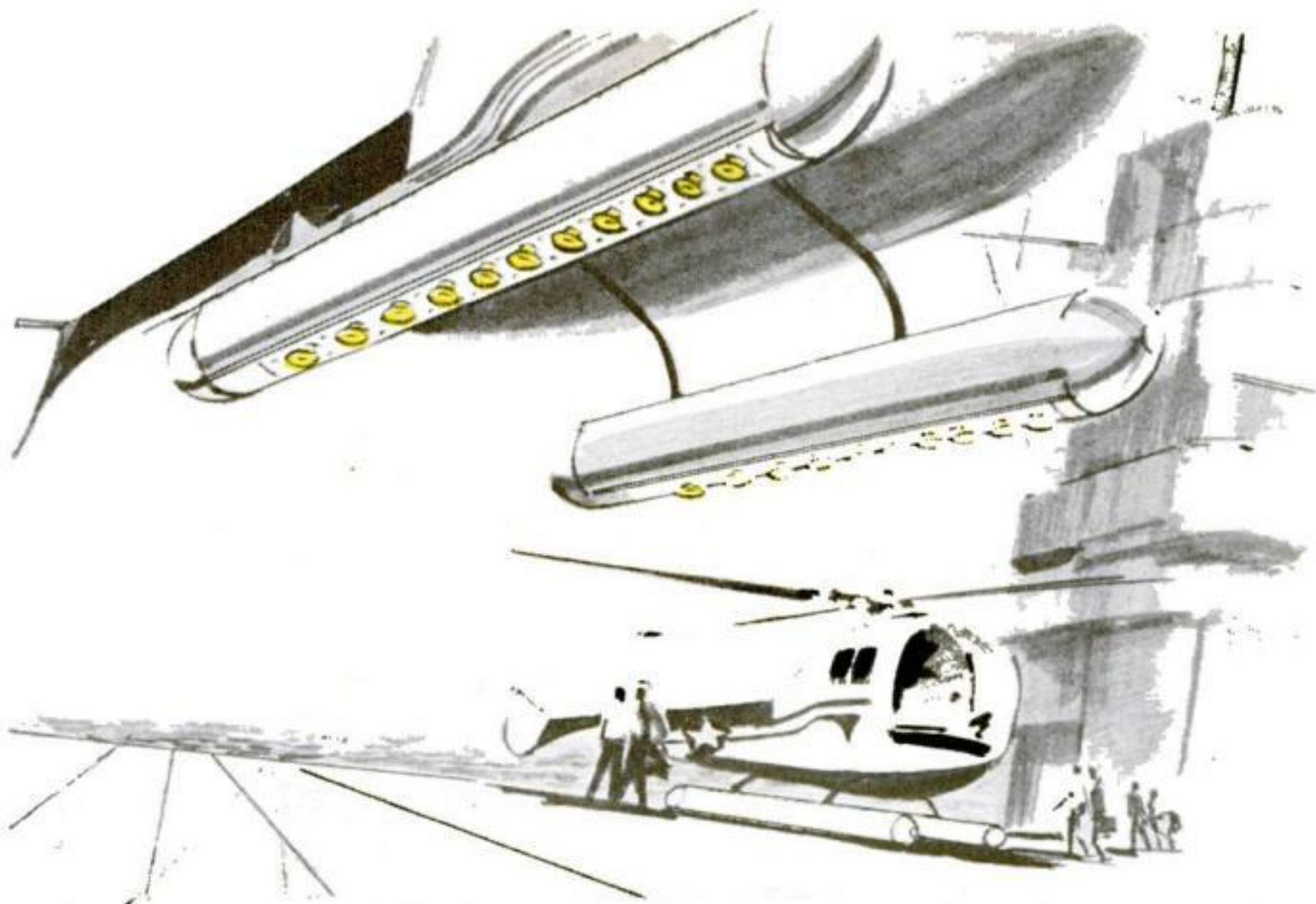
**The requirements.** "Let's consider how we might modify an Earth plant to suit life on Mars. What we want is something that can thrive on almost no oxygen or water; on extremes of temperatures; and that can take doses of ultraviolet light that get through.

"The ultraviolet problem is probably the simplest. You suppose built-in shielding pigments. You don't even have to suppose them. There are fungi in Death Valley that do have them.

"The temperature requirement isn't so tough either. A plant would have to

[\[Continued on page 204\]](#)





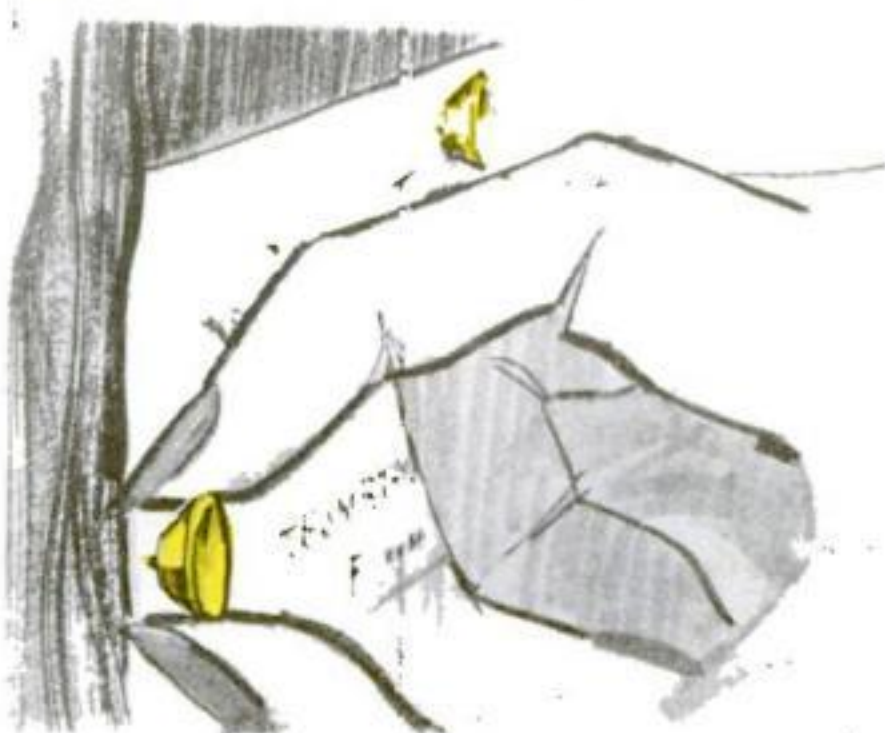
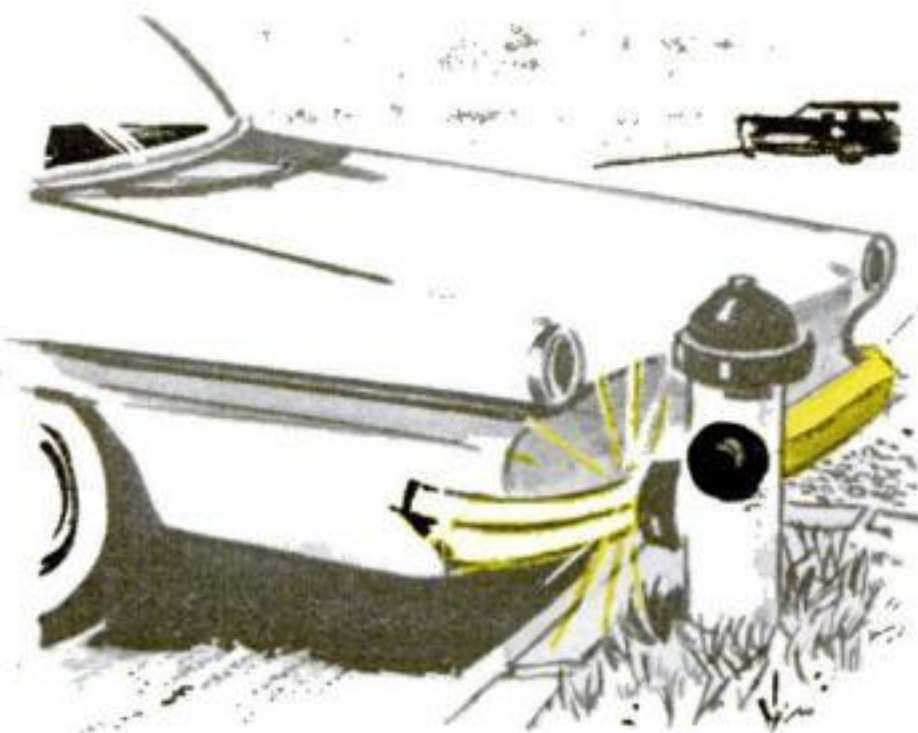
**Suction cups help copter land.** A helicopter could land or take off safely from even a wet or pitching carrier deck if it had this recently patented gear. Suction cups set

in the floats would let down to provide a firm grip. For takeoff, pilot-controlled slots near the cups would admit air and break the grip of the cups.

# New ideas from the inventors

**Bumper brake stops car.** To avoid damage caused by backing a car or truck into unseen obstacles, valves in this bumper mount would transmit pressure to a brake-setting plunger—far faster than driver reaction could do it. The mechanism would engage only when the vehicle was backing.

**Concave tack head fits fingers.** You could push—or pull—a thumbtack without risking broken fingernails if it had a shaped head like this. The concave crown would form a thumb-fitting pushing surface. And even fully inserted, the tack, with its raised edge, would be easy to pull.





## More inventors' ideas



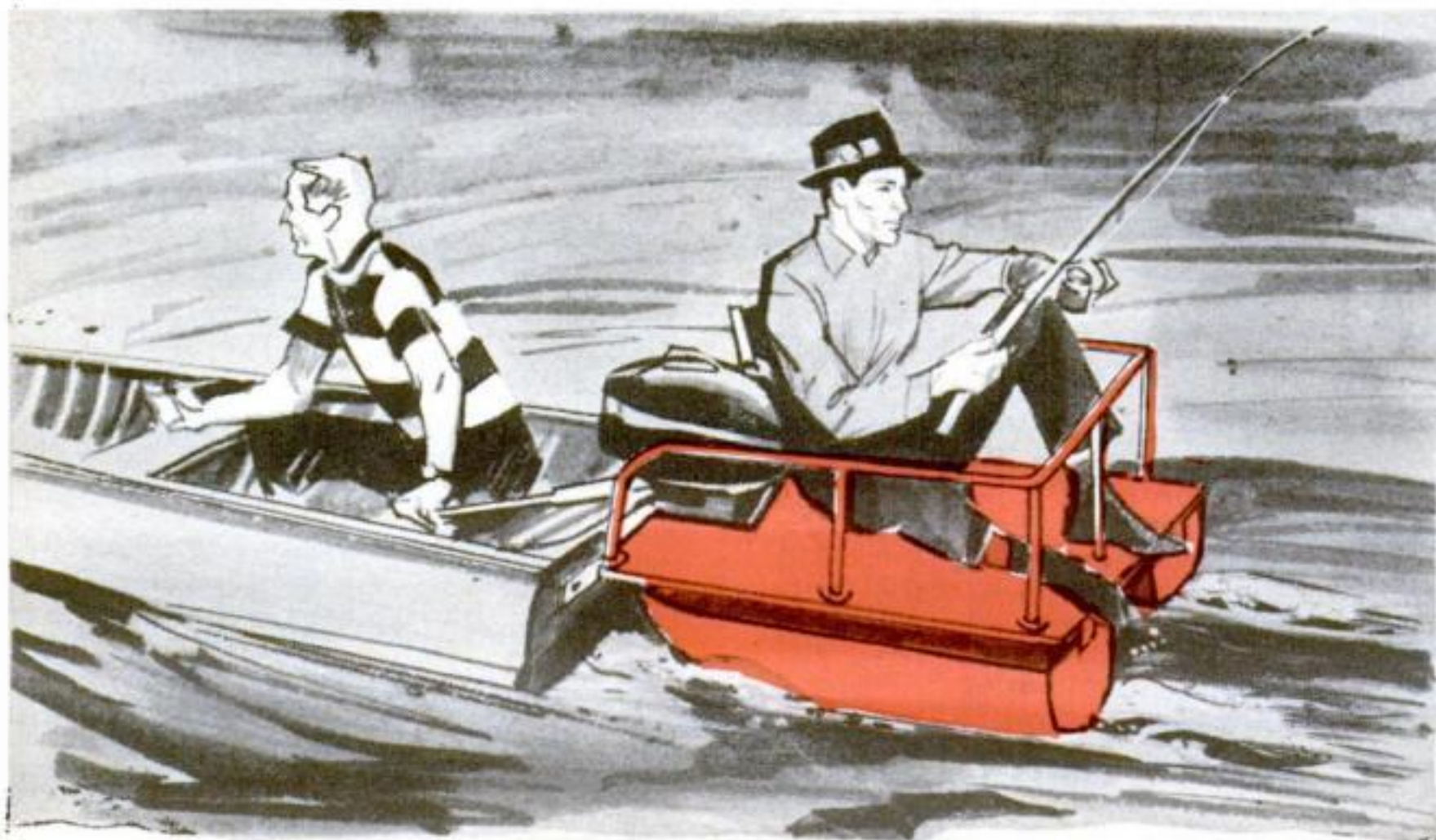
**"Gun" finds the fire.** A focusing mirror and infrared sensor in the barrel of this pistol-shaped detector—and a meter in the grip—would help fight fires by pinpointing hot spots hidden by smoke or walls. Improving a fireman's "aim" could help minimize water damage and expose unseen blazes that might be overlooked.



**Storm window encloses cooler.** Shaped to fit around an air conditioner, this rigid, one-piece plastic enclosure could be trimmed to a snug window fit to simplify winter-sealing your house. It would stop drafts better than conventional storm windows and protect the air conditioner during its winter layover.

**Outboard float extends deck.** A hydrofoil-supported platform like this could add several feet of deck space to an outboard-driven boat and let you troll with little

danger of snagging your line in the prop. Bolted to the stern, the platform would ride on pontoons spaced far enough apart to clear the engine and its wake.

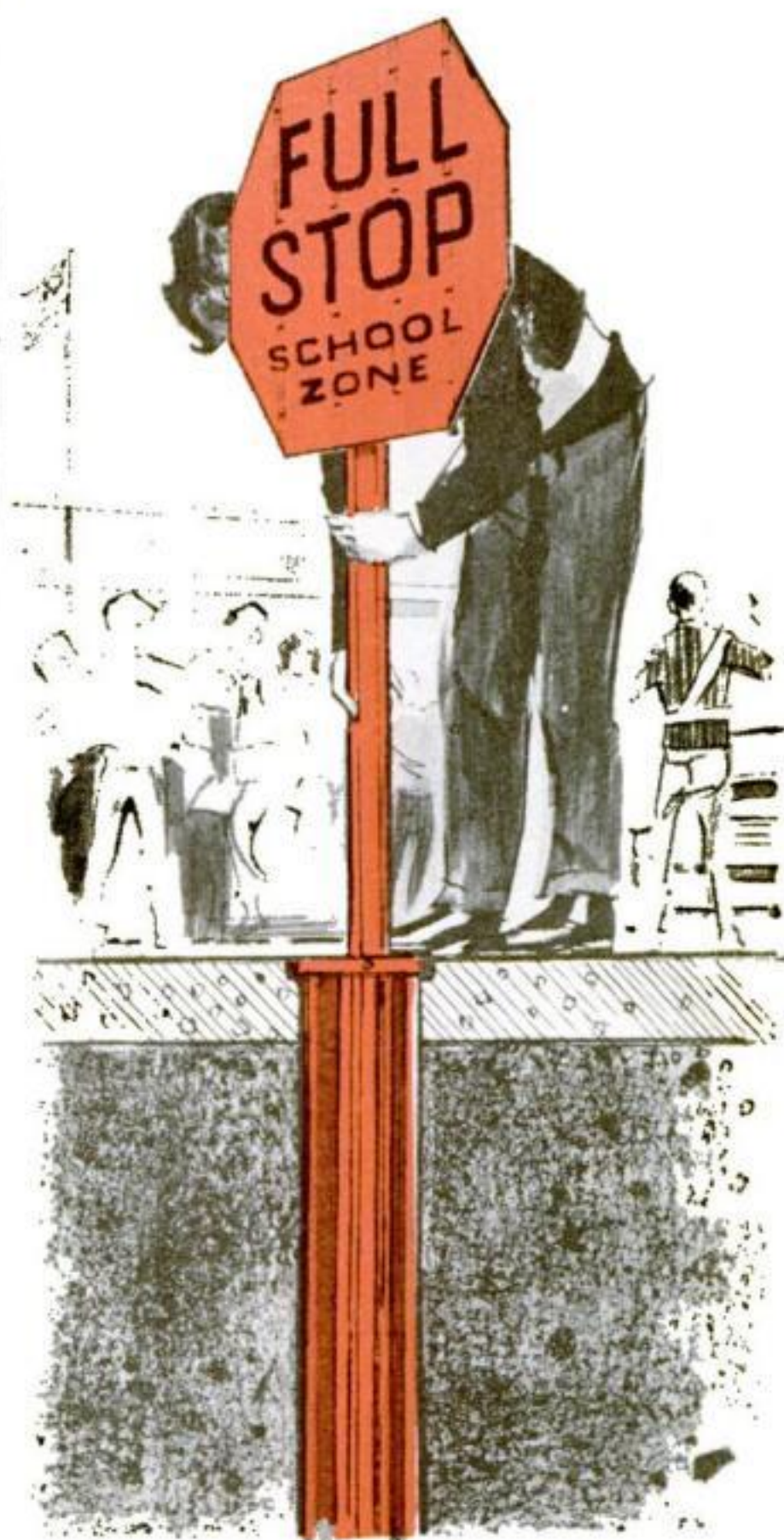
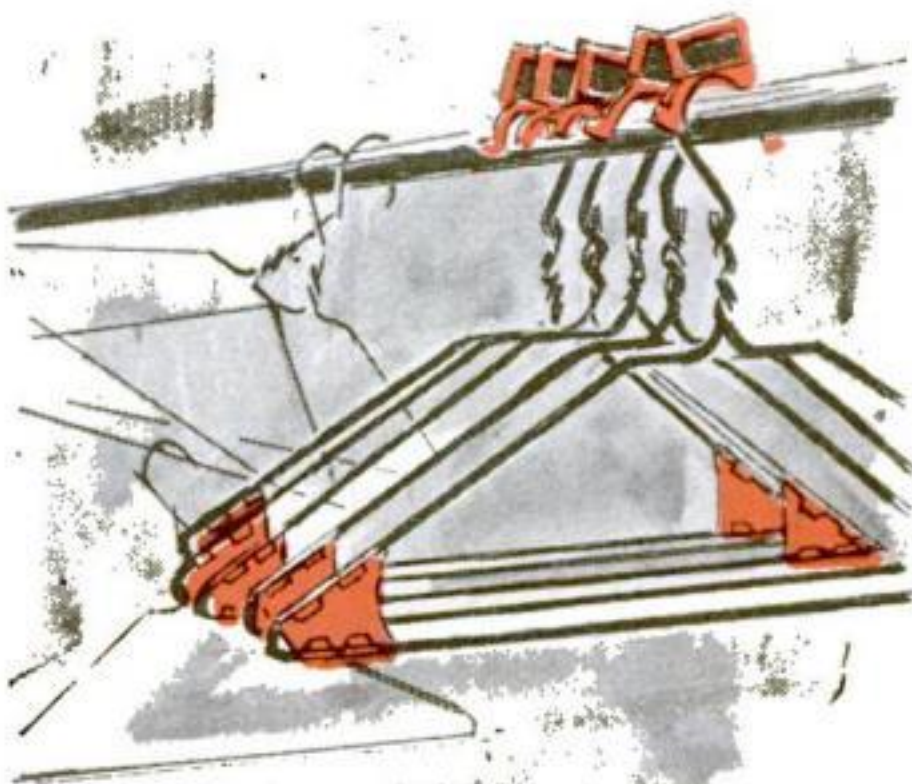






**Card charges phone calls.** Credit-card phone calls might be speeded with the cards and phones covered in this Bell System patent. When you inserted your card in the slot of a phone, information coded in metallic ink would be transmitted to a central station to be checked and recorded along with details of your call.

**Guard prevents hanger snarls.** Wire clothes hangers couldn't tangle themselves in your closet if you (or your tailor) attached guards like these to the hooks and corners. Made of resilient plastic, the hook guards would be slotted to slip over the curved wire. Fingers stamped in the corner guards would hold them in place.



**Sign unfolds from pavement.** To put school-hour traffic control into effect without having to roll out a heavy stanchion, a student monitor or teacher would just lift and unfold this retractable sign. Lowering it into the pavement would restore off-hour driving regulations.

*The following patents have been issued on these inventions: Copter cups—No. 3,013,747 to A. Grihaugne and A. Paton, Paris, France; Bumper brake—No. 3,023,829 to J. Kuttler, Lafayette, Calif.; Tack—No. 3,009,382 to L. Salka, Botsford, Conn.; Fire "gun"—No. 3,017,513 to S. Messelt, Wilton, Conn.; Storm window—No. 3,002,236 to F. Humphrey, River Forest, Ill.; Outboard float—No. 3,019,755 to J. Diamond, Washington; Phone card—No. 3,022,381 to W. Pford, Watchung, N.J.; Hanger guard—No. 3,024,953 to J. O'Keefe, Amarillo, Tex.; Sign—No. 3,029,713 to M. Hopson, Grafton, Va., and R. Hammond, Durham, N.C.*

*Copies of patents may be ordered, by number, from the Commissioner of Patents, Washington 25, D.C., at 25 cents each. To write to an inventor, if the address given above is insufficient, address him (by name and patent number) in care of the Commissioner of Patents.*



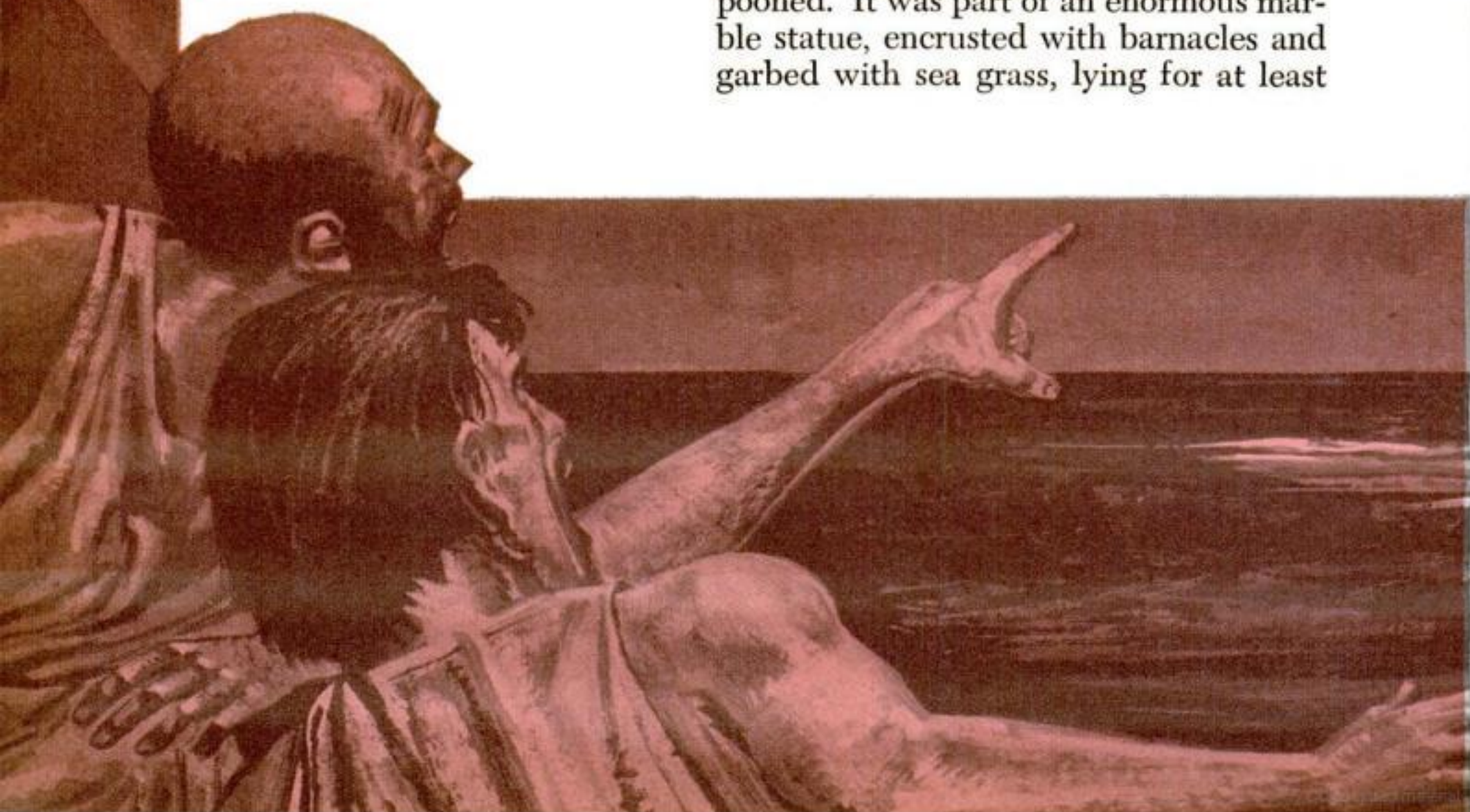
Earthquakes and man-made disasters may

# Have They Found the 2,000-Year-Old Pharos Lighthouse?

BY  
WESLEY S.  
GRISWOLD

*Alexandria, Egypt*

ONE day about a year ago, a skin-diving Egyptian fisherman plunged into the clear waters off Fort Kait Bey, a graceful arm that Alexandria stretches into the Mediterranean. At a depth of 21 feet the diver was dazzled by the sight of something much bigger than any fish he might have harpooned. It was part of an enormous marble statue, encrusted with barnacles and garbed with sea grass, lying for at least





have toppled the tower into the sea

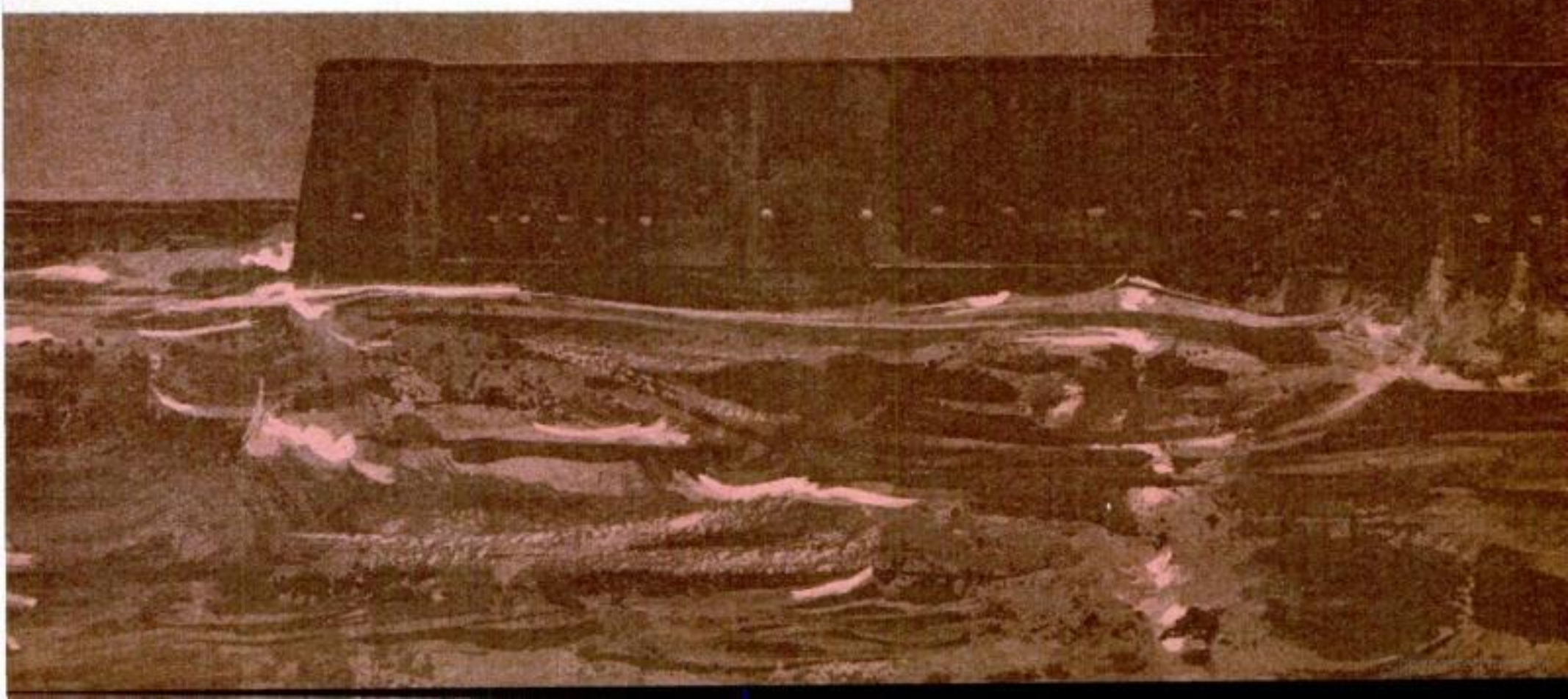
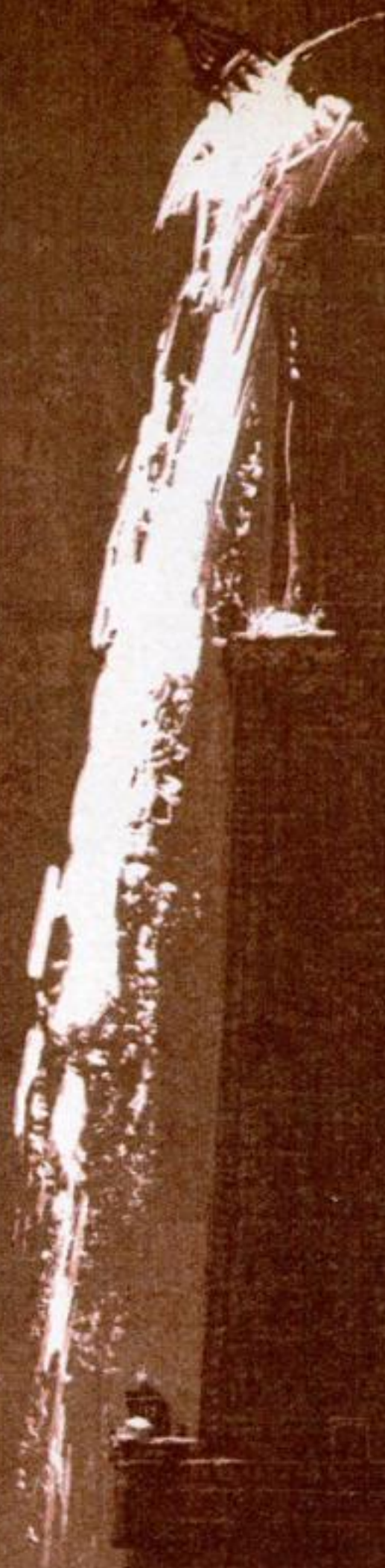
20 feet along the sandy sea bottom. Nor was that all he saw. Nearby were a sphinx, a smaller statue, and a stone column.

Were these fragments of one of the Seven Wonders of the World—the fabulous Pharos Lighthouse? The 500-foot tower, the world's first (and probably tallest) lighthouse, had guarded Alexandria's eastern harbor for a thousand years, up to 700 A.D. Then a series of earthquakes and man-made disasters gradually wrecked it so that by the middle of the 14th century there was nothing left but rubble. Later, on the ruins, the Mameluke Sultan Kait Bey built a walled palace which, while considerably rebuilt, still stands today—a cream-colored majestic silhouette against the startling Mediterranean blue.

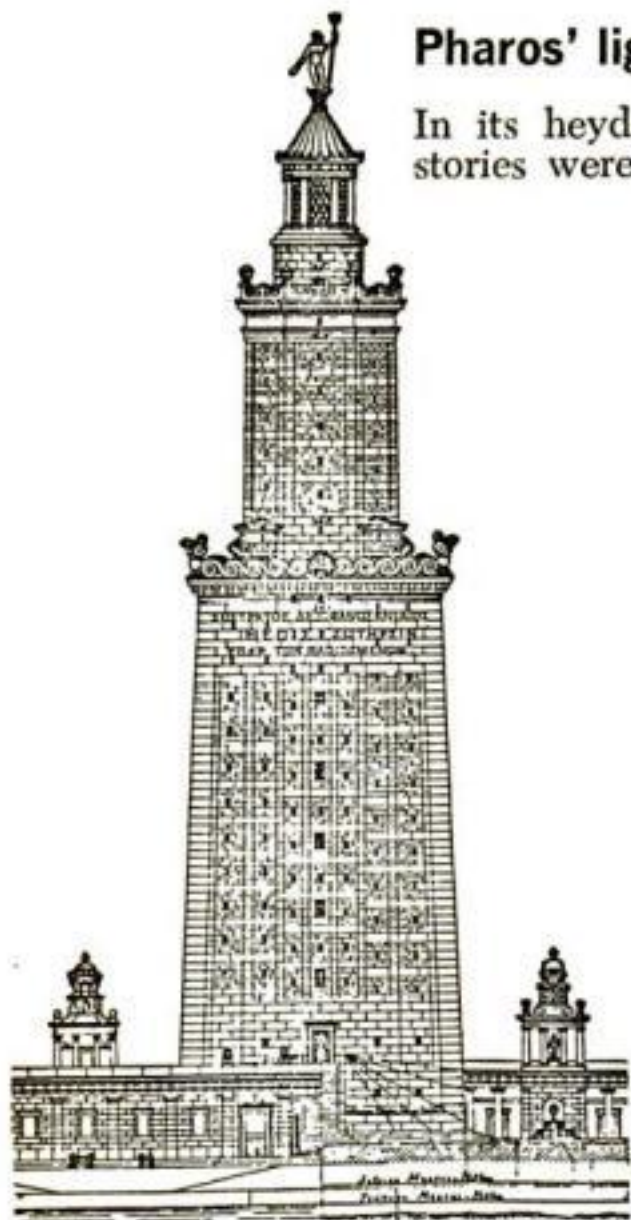
The United Arab Republic's Department of Antiquities quickly sent navy frogmen to the scene to check the skin-diver's report. They confirmed it. The marble pieces must have been part of the elaborate statuary that decorated the tower. The Pharos toppled into the sea right there, archeologists declared.

Now—this September—when the wind

CONTINUED







## Pharos' light was a bonfire you could see for 60 miles

In its heyday, Pharos was four-tiered. The base was square; upper stories were octagonal and round. Light stood in space below statue.



Today a sultan's castle stands on the site. Dark stones at the base of towers and above door are granite from Pharos.

switches from north to south and the waters along Egypt's north coast turn calm enough to resume investigation, authorities will have a chance to resurrect the pieces and settle the mystery. The underwater photographs taken last year showed just enough to tingle enthusiasm, but not enough to identify any object positively. The finds, while not the first of their kind along the sea walls that flank the entrance to the older of Alexandria's two harbors, were clearly the most important to date.

Dr. Henry Riad, the tall, lean, brown-haired curator of the city's famous Greco-Roman Museum, will be in charge of the explorations. An Egyptian Christian who got his Ph.D. at the Sorbonne, Dr. Riad speaks English well. In late April, in his high-ceilinged little office whose windows overlook a blaze of red Bougainvillaea, he told me the story of the famous Pharos Lighthouse and what he hoped to find.

**A bonfire for the ancients.** "Not much is known positively about the great lighthouse," he said with a deprecating grin. "But its light was said to be visible 60 miles at sea."

"The light must have been a fire," I suggested.

"Oh, yes," Dr. Riad replied, "a bonfire, probably fed with palm logs and with a reflector behind it. We believe this must have been made of polished granite. Most regrettably, it was destroyed about 700 A.D. There's a legend that men seeking Alexander's treasure, rumored to be buried there, pushed the reflector off its perch."

"Do you think you'll find parts of it buried in the sea bottom?" I asked.

Dr. Riad shrugged.

"There's no telling what we'll find. That statue the skindiver found was first thought to be part of a huge statue of Poseidon, the Greek god of the sea, that stood at the very top of the Pharos. Instead, the few photos taken of it under water show clearly that it is the statue of a woman. It could be the goddess Isis—we know there was a temple to her near the Pharos. Or it might be Diana."

Dr. Riad went on to tell me what the most reliable authorities believe the Pharos was like.

It stood in a high walled enclosure—

*[Continued on page 206]*



## DOOMSDAY BOMB

.....

# Man's Last Big Blast

BY MARTIN MANN

**L**EAKING past security are hints of a new and terrifying weapon: the Doomsday Bombs. These are Gargantuan bombs designed, in their ultimate form, to put an end to the world.

They pose a completely new kind of danger to mankind, so grave that it is difficult to grasp. These are not just bigger and deadlier bombs. They are, as no weapon before has ever been, the ultimate weapon. They could put our entire planet at the mercy of a few men possessing a few pushbuttons.

**T**HE first tip-off was the Russian A-tests last fall. Our tests this spring may have pointed the same way. No official will say that Doomsday Bombs are now being developed. But meager announcements in speeches dovetail with published facts on hydrogen bombs. Several scientists have already put together parts of this jigsaw puzzle, sketching a picture documented with convincing detail.

The Doomsday Bombs they foresee are not military weapons. Such bombs cannot be used to win a war; *everybody* on all sides gets killed. Instead, they would permit vicious blackmail. They become the international equivalent of the bottle of nitroglycerin waved by the bank robber—the guy who walks to the teller and threatens to blow up everything, himself included, unless he gets the money.

Does total war then become total

suicide? Are fallout shelters useless—or worse than useless? Could any two-bit tyrant, by threatening universal destruction, blackmail the whole world?

Herman Kahn brought up Doomsday in his blood-curdling treatise, *On Thermonuclear War*. He outlined three technical ways to bring about the end of the world:

1. Change the climate drastically.
2. Burn everything up in a global holocaust.
3. Kill all living things with radioactivity.

Doomsday No. 1 is at present pure science fiction. (In fact, it's the basis of the plot of a British movie, *The Day the Earth Caught Fire*, now playing in the U.S. The earth tilts on its axis, with lurid effects.)

But the other two schemes have been worked over by scientists:

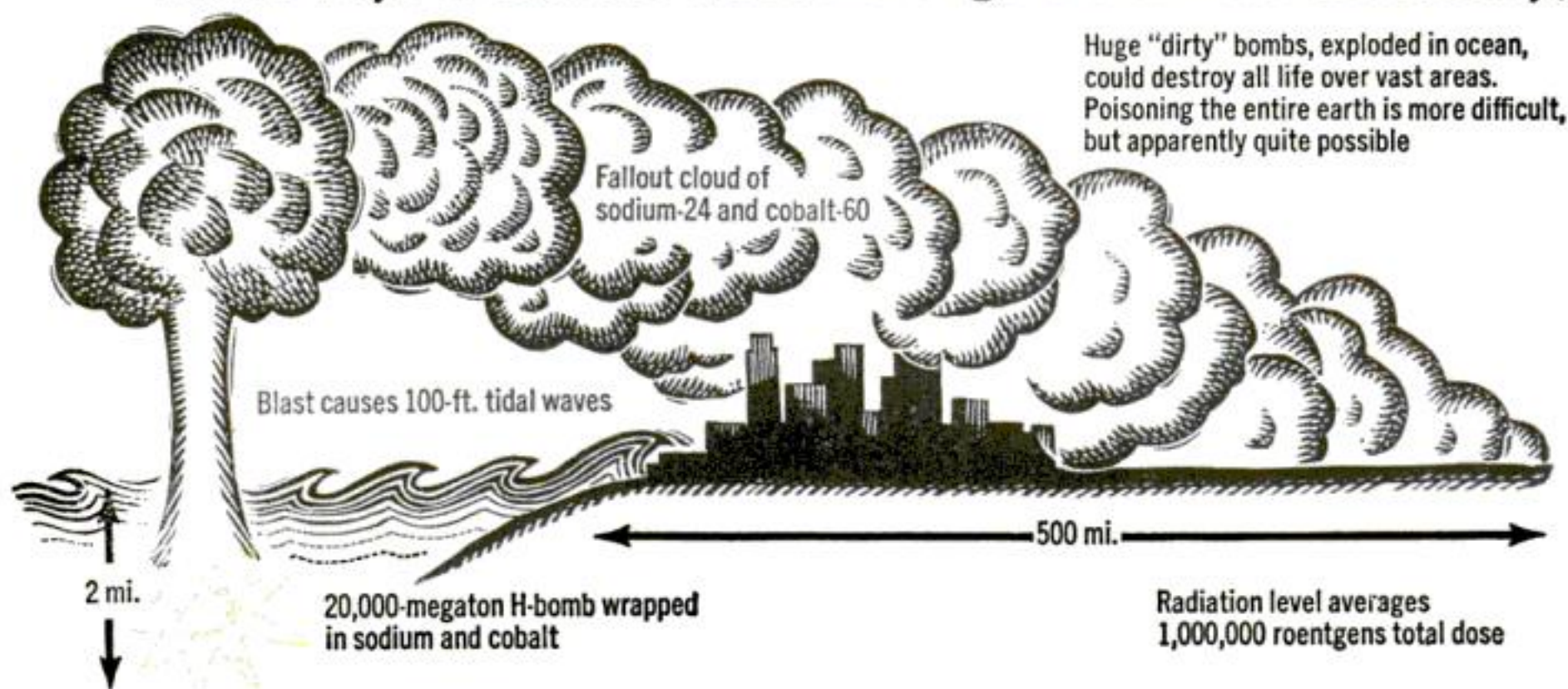
First will come not-quite-Doomsday Bombs—country-busters, which

CONTINUED

III



## Three ways to end the world: change the climate drastically,



at one blow could wipe out a whole nation and quite possibly a continent.

Finally the country-busters will be "improved" to true Doomsday weapons, which could ring down the curtain on humanity.

**How big is big?** The country-busters start as large H-bombs—very large, possessing explosive power of 1,000 megatons (equivalent to a billion tons of TNT). The Russians have a 120-megaton "device" now. It was tested last fall, but muffled with a lead jacket to hold the actual explosion down to 58 megatons. So the country-busters require only a tenfold increase over what already exists. That is fairly easy. Bombs of *any* size can be made. There is no limit.

The more explosives used, the bigger the boom. The explosive, unfortunately, is cheap and easy to come by, at least on the scale of modern military budgets. It is deuterium, the special form of hy-

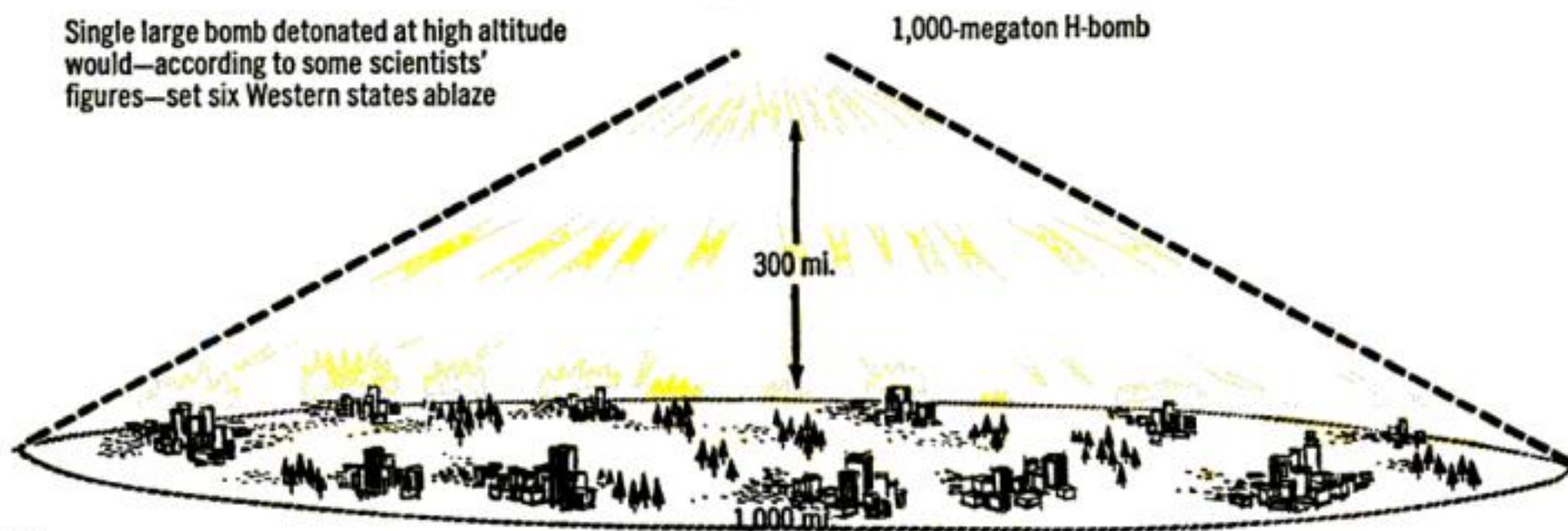
drogen that can be separated from ordinary water.

Deuterium oxide—heavy water—is in commercial production today in many countries. It sells for \$20 to \$30 per pound. A 1,000-megaton bomb would need 50 tons of heavy water—a few million dollars' worth. Bombs of this size are not simply more destructive. They can wreak completely new kinds of horror.

**How to burn up the world.** The fantastic power of an H-bomb comes out largely as heat. It's as though a miniature sun lit up near the earth. Even the piddling 20,000-ton A-bomb exploded above Hiroshima started fires over an area one mile across.

Larger bombs generate more heat. But there's more to it than that. How the bomb is used makes a big difference.

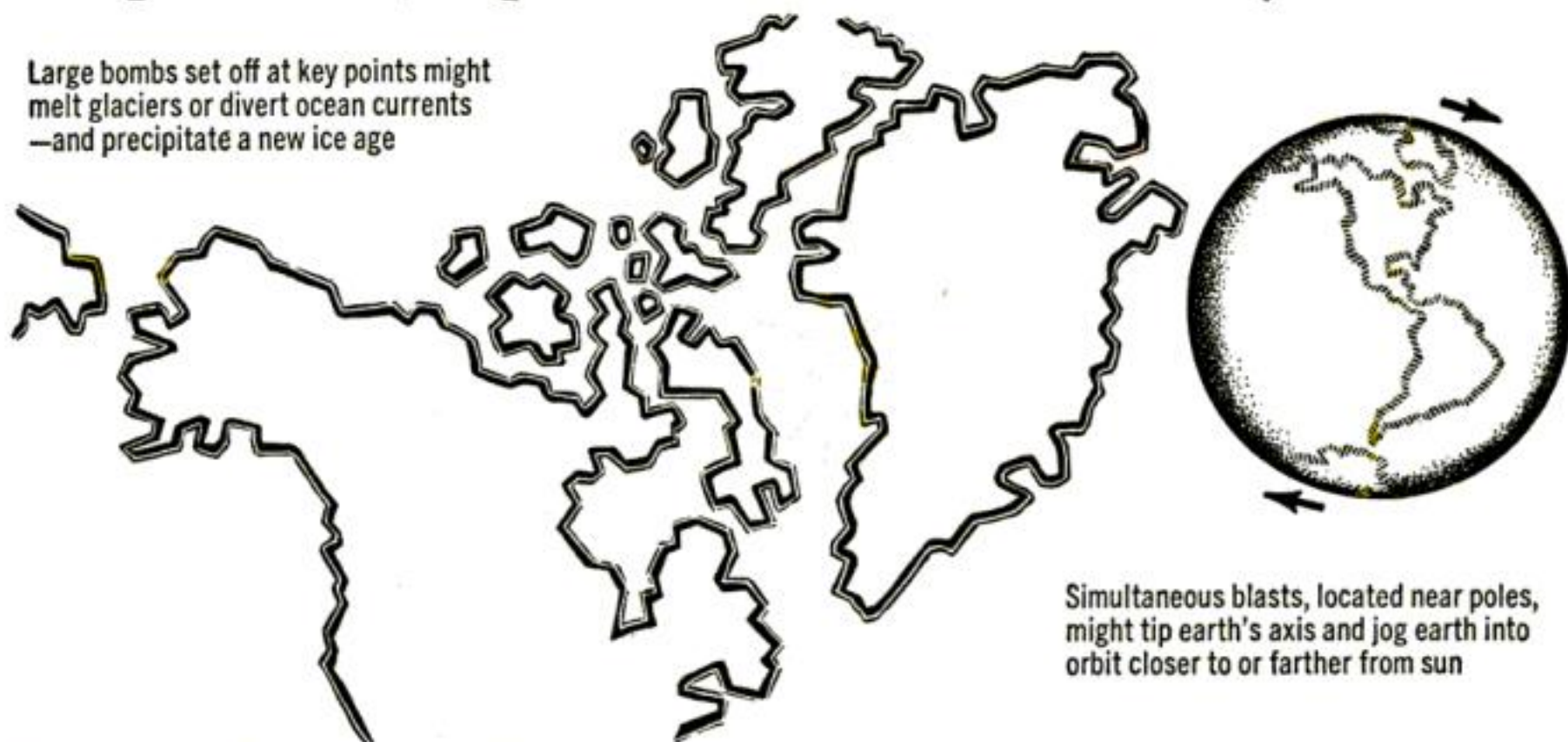
An explosion on or near the ground heats up the air, making it expand and





## burn up the earth, or poison all life with radioactivity

Large bombs set off at key points might melt glaciers or divert ocean currents—and precipitate a new ice age



Simultaneous blasts, located near poles, might tip earth's axis and jog earth into orbit closer to or farther from sun

blast everything to bits. The blast pulverizes a large area, but not a continent or even a state.

If the bomb goes off very high up, there is no air to create blast. But without air, the heat is not absorbed. It travels like light in straight lines, unimpeded, for very long distances above the atmosphere. Then it sears the ground over a tremendous area, almost as if the bomb were everywhere overhead.

Official AEC figures indicate that a single 1,000-megaton bomb exploded about 10 miles up would set fires over 283,000 square miles. That covers the state of Texas, with a little left over. According to unofficial calculations, a higher explosion—a few hundred miles up—would ignite six Western states.

**Firestorms and conflagrations.** There is worse. These scattered fires might link up into gigantic fire storms. A small fire storm burned out part of Hiroshima,

and a much worse one ravaged Hamburg, Germany, after a nonatomic incendiary raid July 27, 1943.

A fire becomes a fire storm when it creates such a strong updraft that it sucks air and flames inward from all around. At Hamburg the updraft was 1½ miles across and rose 2½ miles into the sky. Air rushed toward the center at 150 m.p.h. and crushed fire trucks in the streets. The temperature went to 1,500 degrees. People in shelters were either incinerated or suffocated. That night 60,000 people died.

But a fire storm burns toward its center so it destroys only a limited area. (That is, if you can call six Western states a limited area.) A "conflagration" might be worse. This is a fire that burns with the wind. It consumes everything in its path and doesn't stop until the wind reverses or there is nothing left to

[Continued on page 214]



Separate fires could join into fire storm, which burns inward to destroy everything in its area



Wider areas might be incinerated by a "conflagration," which races along with the wind

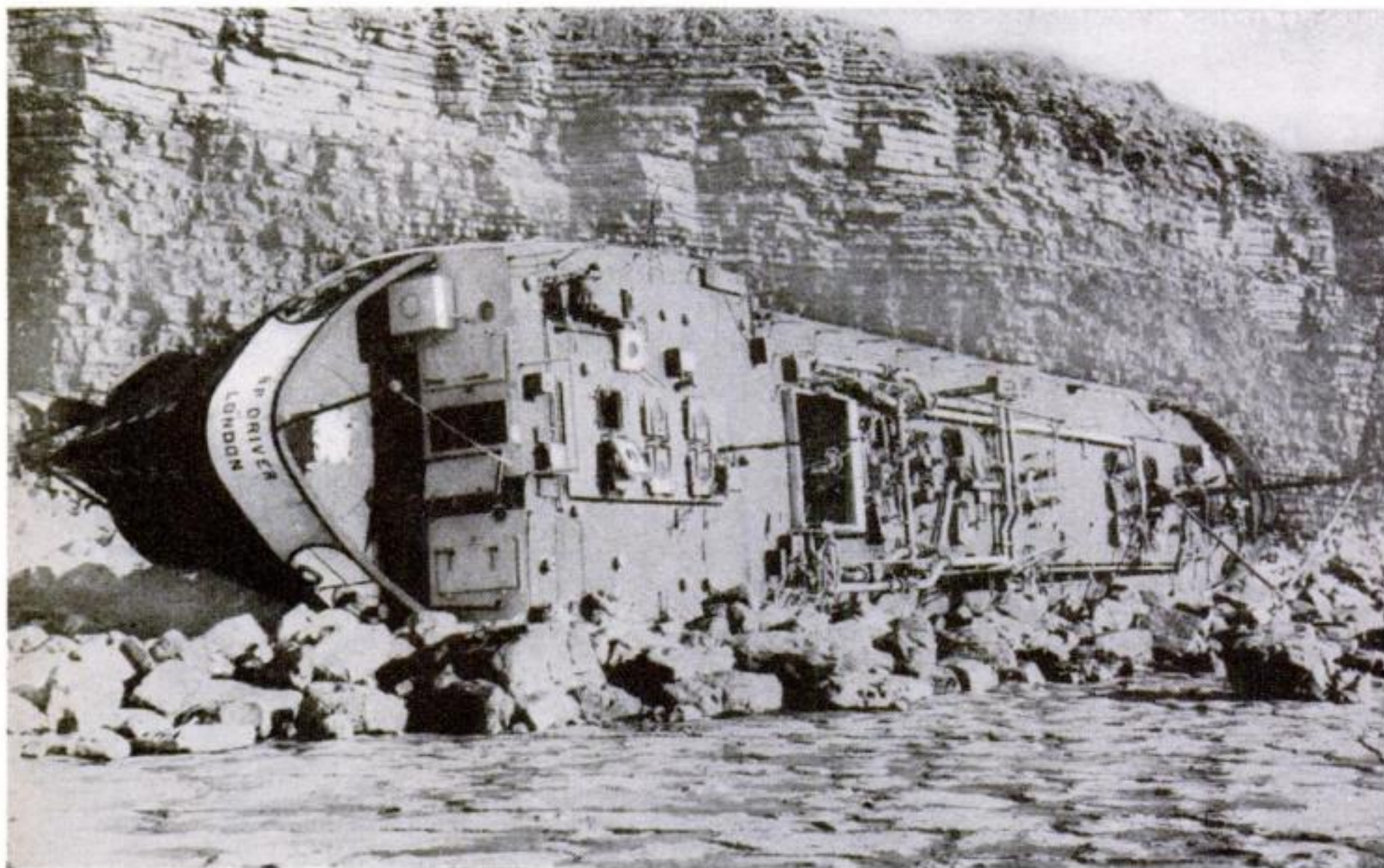




## Renault makes new model

Soon to reach these shores is this latest Renault, slightly larger than the familiar Dauphine. Also rear-engined, the four-door R8 is powered by a 58-cu.-in. four with a

four-speed gearbox. It features disk brakes on all four wheels. A built-in heater pumps hot water—not air—for greater interior warmth. Space for luggage, usually skimpy in rear-drive cars, is increased by the squared-off nose.

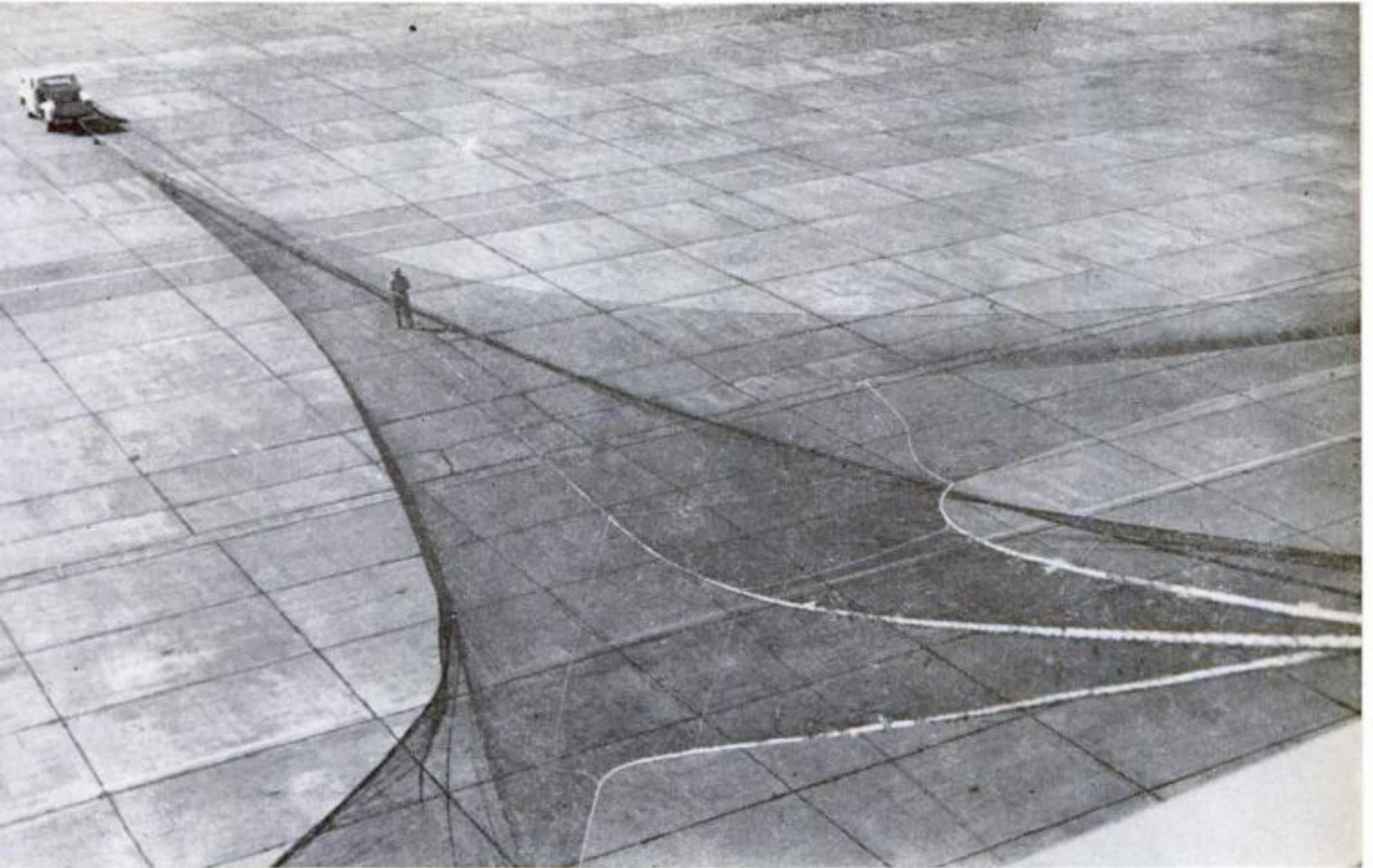


## A hell of a way to run a ship

High and dry on the rocks, the tanker B. P. Driver rests on its side at Nash Point in Glamorgan, Wales, after a storm.

The vessel was pounded on the rock-strewn shore and turned over during the height of the storm. Hopes for refloating her dimmed as successively rough seas pushed her farther up on the beach with each tide.





## Giant net to catch more fish

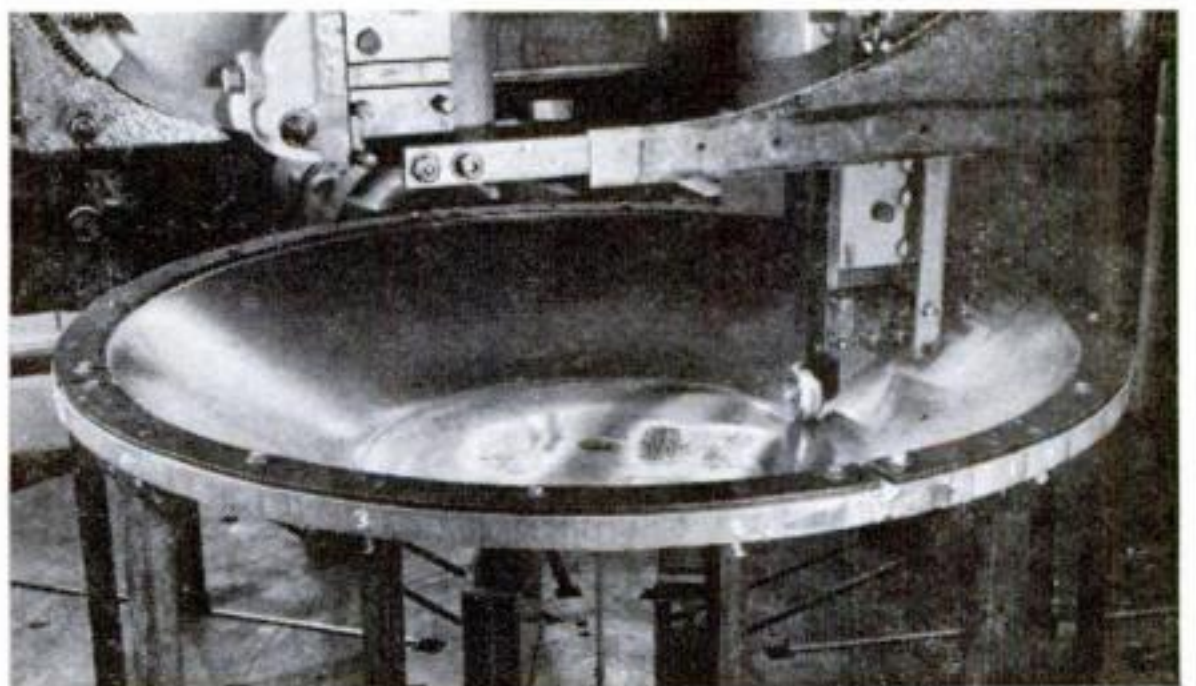
A huge nylon net longer than a football field has been developed by the Bureau of Commercial Fisheries at Seattle, Wash., to

help U. S. fishermen take bigger catches. Towed by a trawler, the 314-foot net is opened and held afloat by four hydrofoils activated by the force of the water. The big net can be handled by four men.



## Ticket starts washer

To forestall the robbing of coin boxes on washers and dryers in self-service laundries and apartment-house basements, Maytag has come up with a plastic ticket that would be purchased by customers. On it is a printed circuit that starts the machine when the ticket is inserted in the slot. A heater lamp in the cabinet shrinks the plastic so the ticket can't be re-used.



## Metal forming without dies

A big boring mill instead of expensive dies and molds is used by GE to shape 6- to 12-foot aluminum disks into parabolic radar reflectors. A roller controlled by a template arm replaces the boring bar. As the faceplate turns, the tool rolls and stretches the flat disk to precision contour, working inward from rim to center. The new method is said to provide greater strength as well as lower production costs for the reflectors.





High seat provides view of surrounding country for miles over low trees and high grass. It's



an excellent perch for spotting wild game, and a good lookout for swamp-hidden pitfalls.

## Safari through tall-grass country by "giraffe" buggy

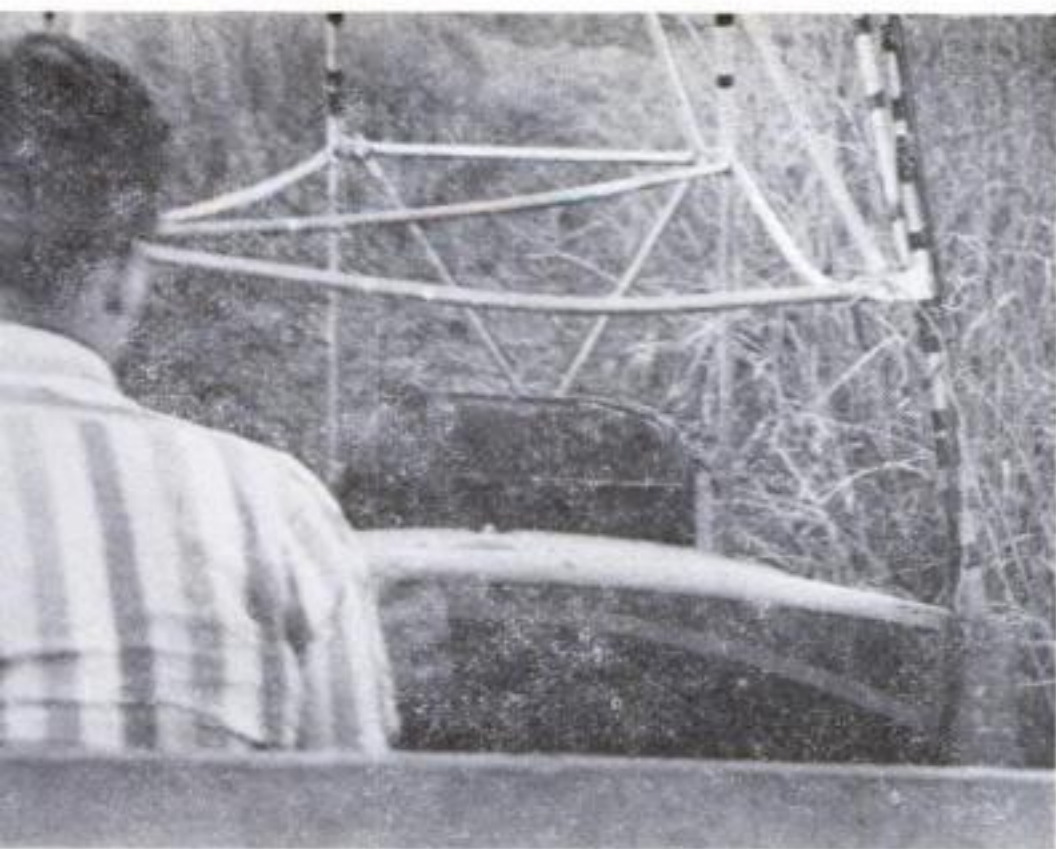
Hunting deer and wild boar in Florida's lower Everglades is great sport from a swamp buggy. Trouble is, the saw grass grows so high it's hard to see the game. Jack Hawkins, a Miami electrical inspector, topped his vehicle with a hunting seat on a 10-foot tower made of lightweight electrical conduit joined with brazing rod and an oxyacetylene torch. It lets him see for miles. So far he has bagged some 30 deer and 25 wild boar.

Hawkins' Giraffe Buggy has two transmissions mounted in tandem. They provide 17 combinations of forward speed. Double reverse is the lowest and most powerful.

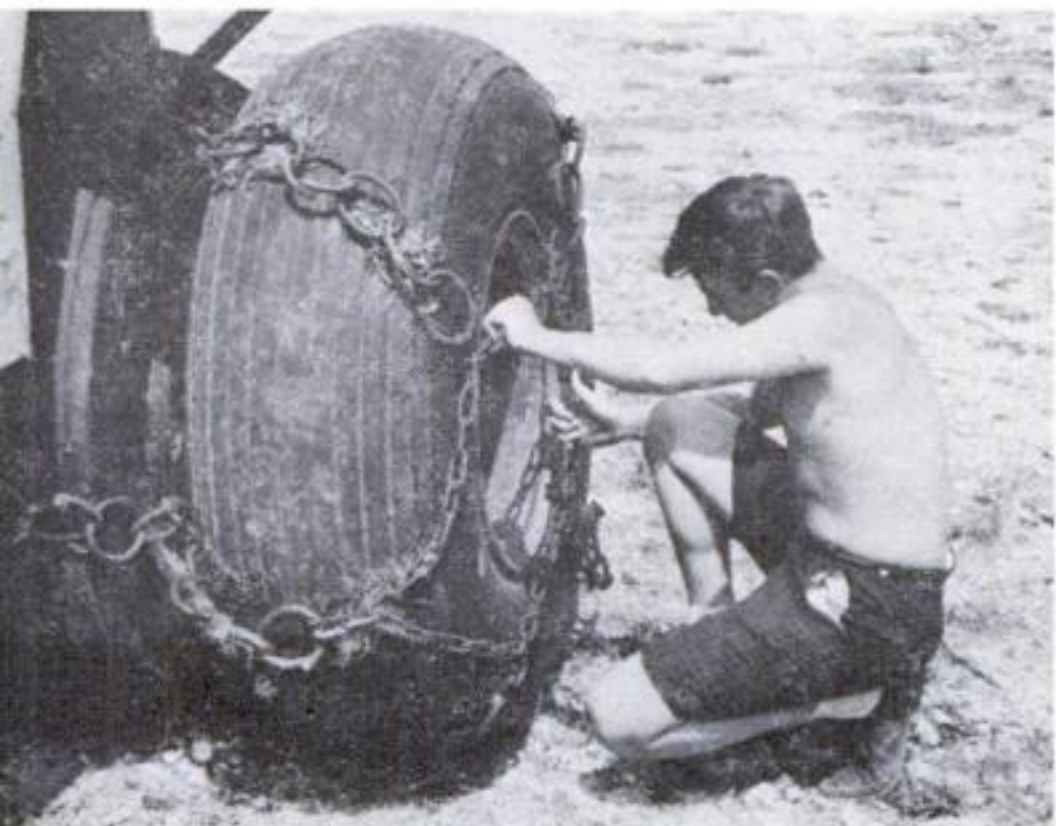
Gas mileage is low: three to five miles per gallon in heavy going. Rubber is second-hand airplane tires: 17.00 by 20 on the rear duals, somewhat smaller in front. The rear rims are 19 $\frac{1}{4}$  inches wide, cut down from 20, and the front a standard 16 inches. With a locked differential on the axle, he cut off the ends to keep the width of the buggy to seven feet and meet highway regulations when it's towed on a trailer.

The Giraffe Buggy will make 45 m.p.h. through flatwoods and at 20 will slash through seven-foot saw grass bedded in a foot of muddy water. A cutoff switch on the tower can kill the engine if the hunter





Seven-foot saw grass obscures driver's vision. He feels way, depending on hunter's eyes above.



Special tire chains have big welded links bent from ½-inch steel concrete-reinforcing bars.

aloft spots a pitfall hidden to the driver. Heavy homemade tire chains give him enough traction for most mud holes. On particularly fiendish trips, he carries a couple of 16-foot cypress logs lashed to the sides. If these can't get him out of the muck, he can call for help by radio.

"Believe me," Hawkins says, "when you get stuck in *this* baby, you're really stuck."

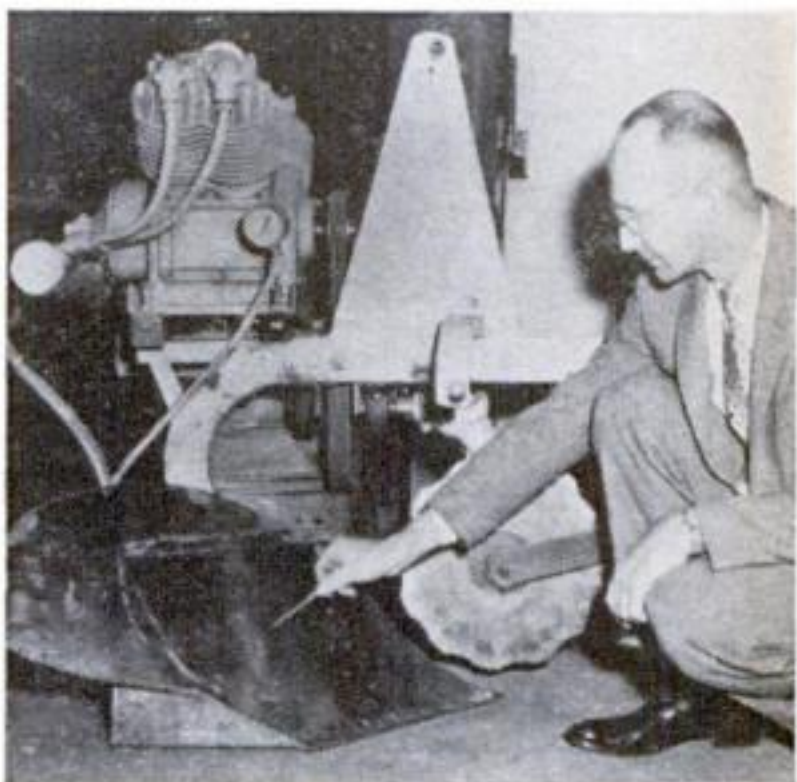
Even on lesser trips, radio is a comfort. It keeps him in touch with his wife in Miami, with a buddy who runs an airboat and swamp-buggy camp on the Tamiami Trail, and with his own camp on the Trail.

Hawkins and his son Eddie built the buggy at a cost of \$1,100 and three years of tinkering and trying.



### Road map geared to speedometer

A strip map on the steering wheel of this British car gives the driver his position. Driven from the speedometer through a flexible cable, it rolls like film in a camera. A light behind the face shows exact location. A slip clutch adjusts for errors caused by detours. Routes are scaled at four inches to the mile. The rolling map was invented by R. B. Bailey of Farnborough.



### Air plow pushes through soil

Air spurting through vents in the moldboard of the tractor-mounted plow above presses aside the earth it turns, eliminates friction, and makes the work easier and faster. The "aeroplough," invented by Dr. William R. Bertelsen of Neposset, Ill., builder of one of the first ground-effect machines [PS, July '59], gets its air from a compressor driven by the tractor's power takeoff. Air lubrication reduces wear on both the moldboard and shear.



## Mechanics and Handicraft SECTION

You'll wonder how you ever  
got along without one—when  
you build and try

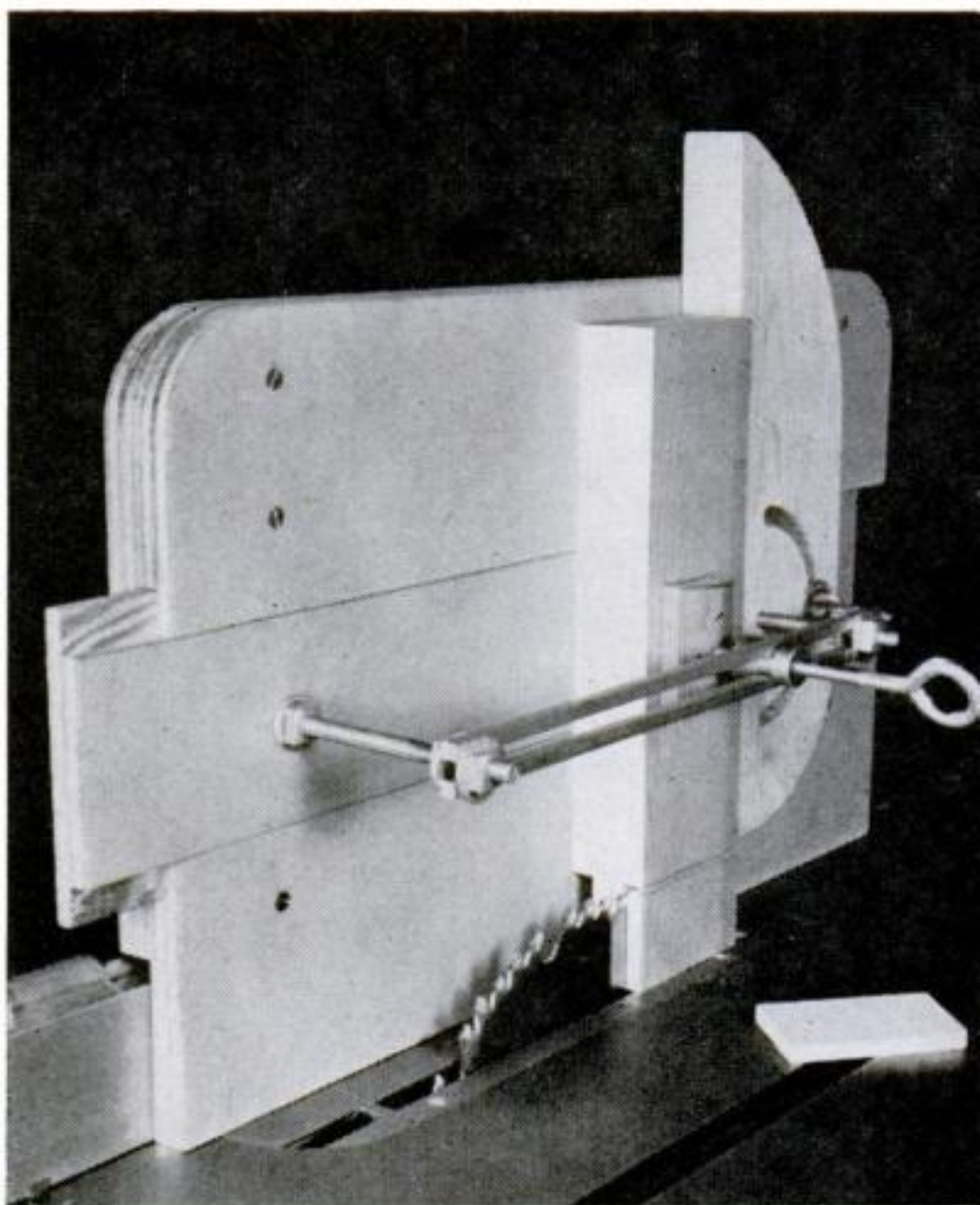
# A Vertical Table for Your Table Saw

By R. J. DeCristoforo

**A** TABLE saw is a mighty useful tool, but this jig will make it doubly so. Imagine locking a one-by-four in a vertical position and moving it smoothly against the blade with your hands safely out of the way. The edge of the board provides little bearing surface on the table, but with this jig it doesn't matter. The board can't tilt, rock, or slide.

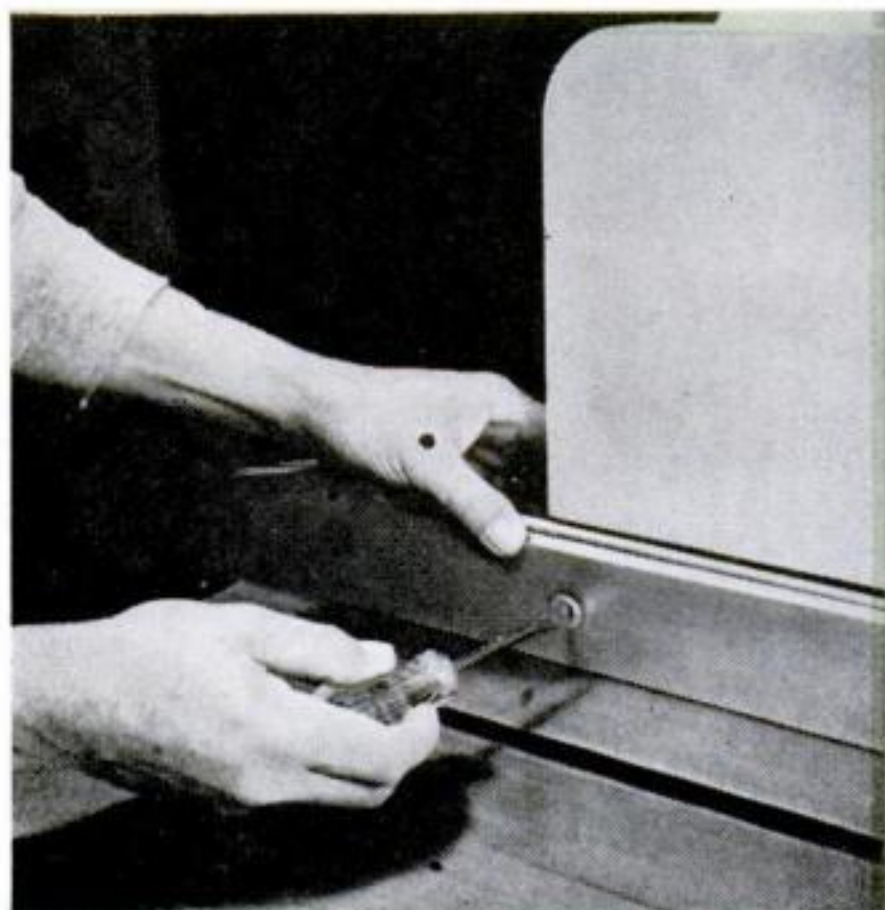
The vertical table is a big step up from the usual sliding, fence-straddling tenoning jig. The miter slide, with its adjustable head, has its own clamp, easily set to suit the position and the size of the work. You can mount the work vertically or at an angle. The jig body locks to the fence. Miter slide, head, and clamp move with the work, giving you the advantages of a sliding table.

The vertical table permits use of the saw blade for some jobs that would ordinarily require a dado—if you were to do



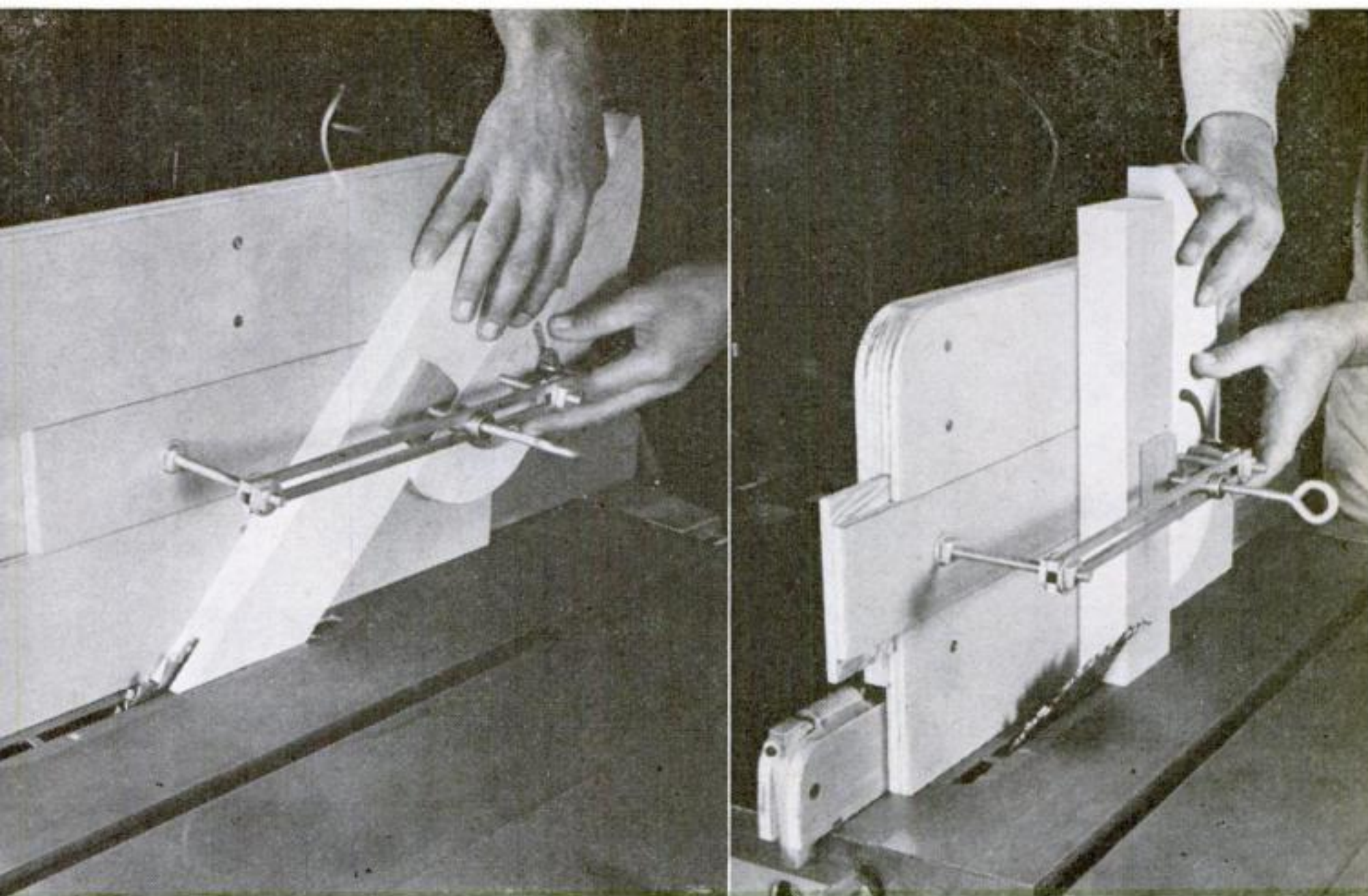
Just look at the kind of

A tenon cut is accurate and safe. The middle member of the jig slides horizontally during the pass; work moves on smooth surfaces above and below it. Note wood pad under the clamp.



The vertical table is attached rigidly to the rip fence with screws. Most fences have holes that you can use. If your fence lacks these holes, you'll have to drill two or three.

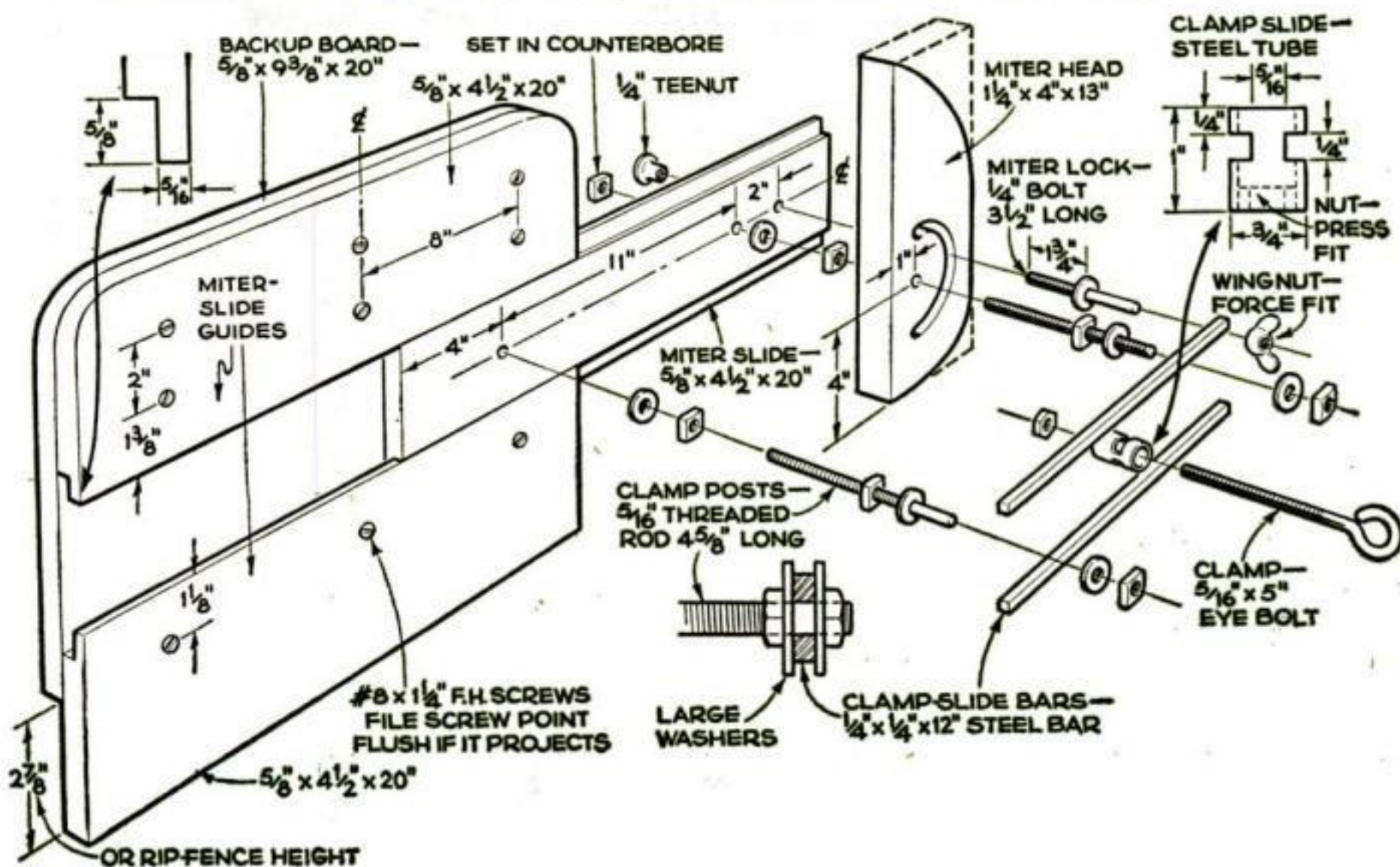




## cutting jobs you can do safely and accurately

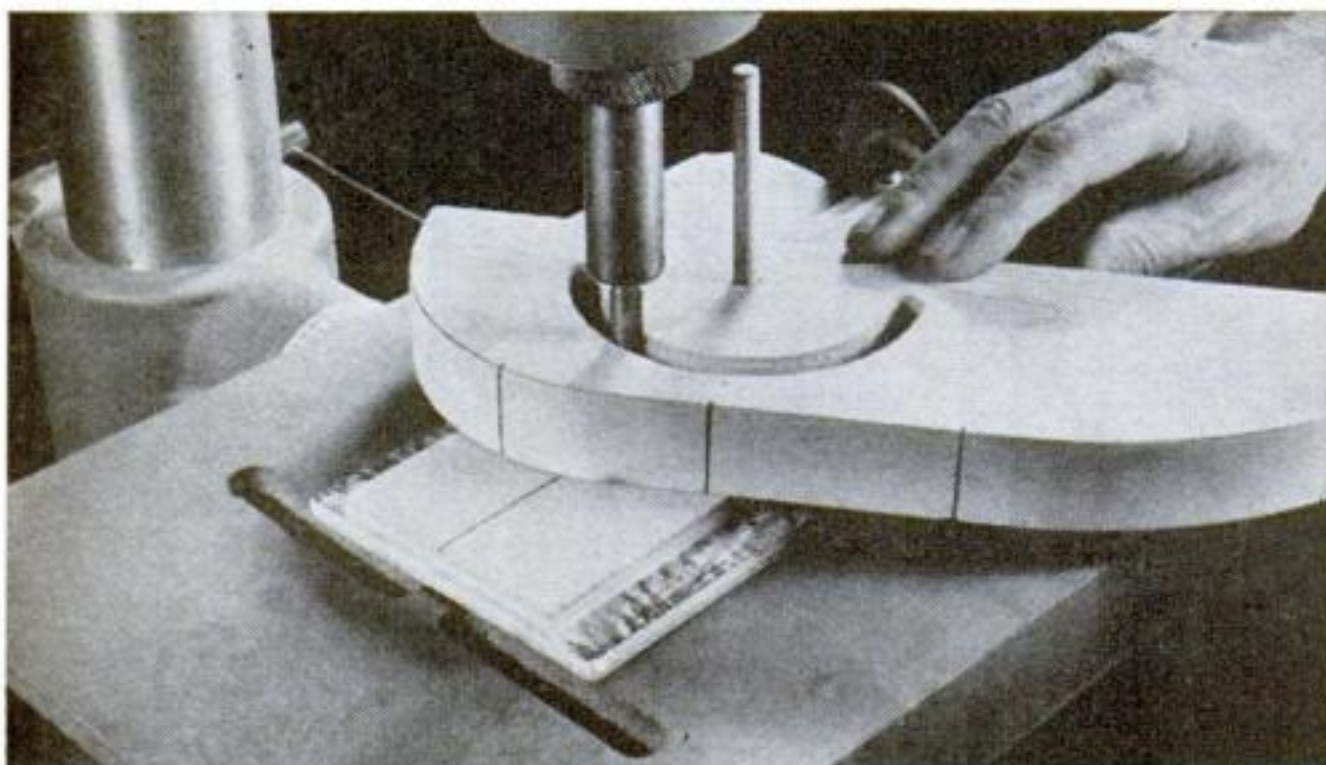
**Splining or grooving a miter?** Simply swing the miter head to suit the work angle. You don't have to center the cut in the stock. Just put the same surface of each piece against jig.

**An angle cut that's difficult or impossible to make with the regular miter gauge** is often a cinch with the vertical table. The work is braced against the miter head during the pass.

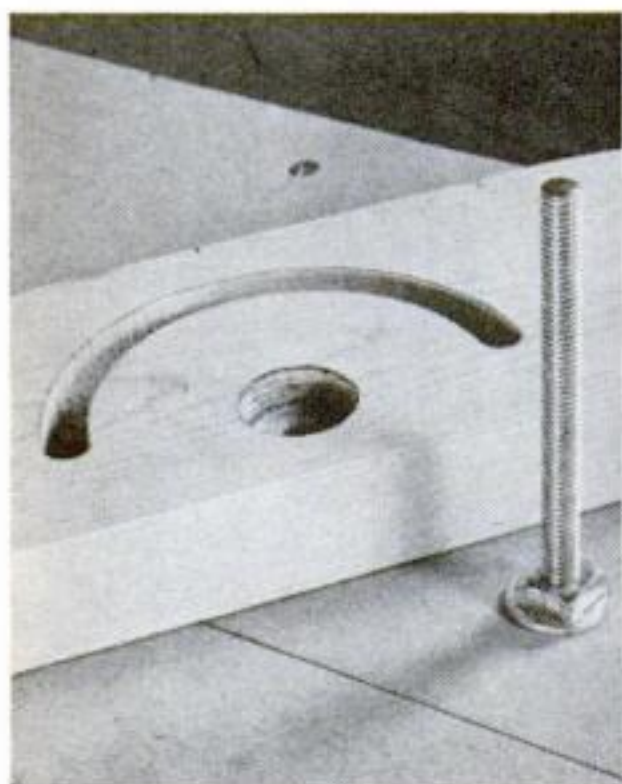




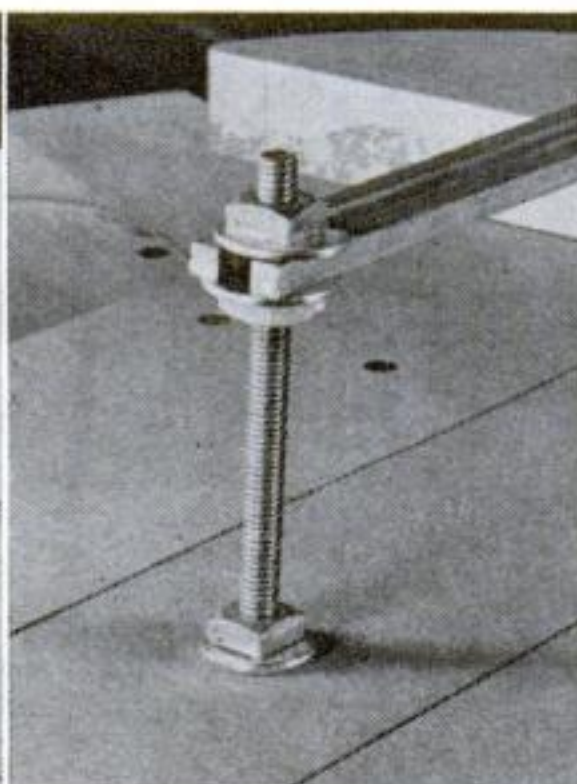
## Important pointers on assembling the vertical saw jig



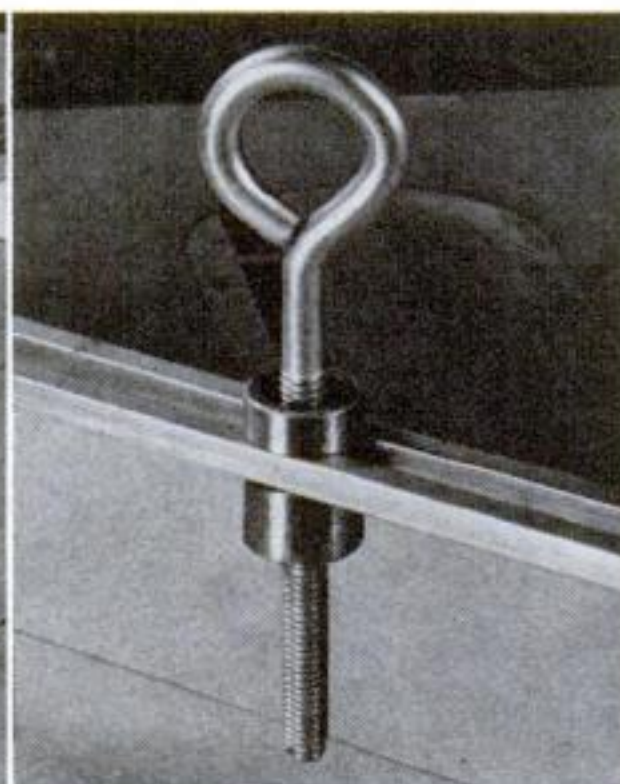
Miter slide, with clamp posts attached, makes a perfect pivot guide for routing  $\frac{3}{8}$ " semicircular groove needed for miter lock. Get full depth of cut with several passes.



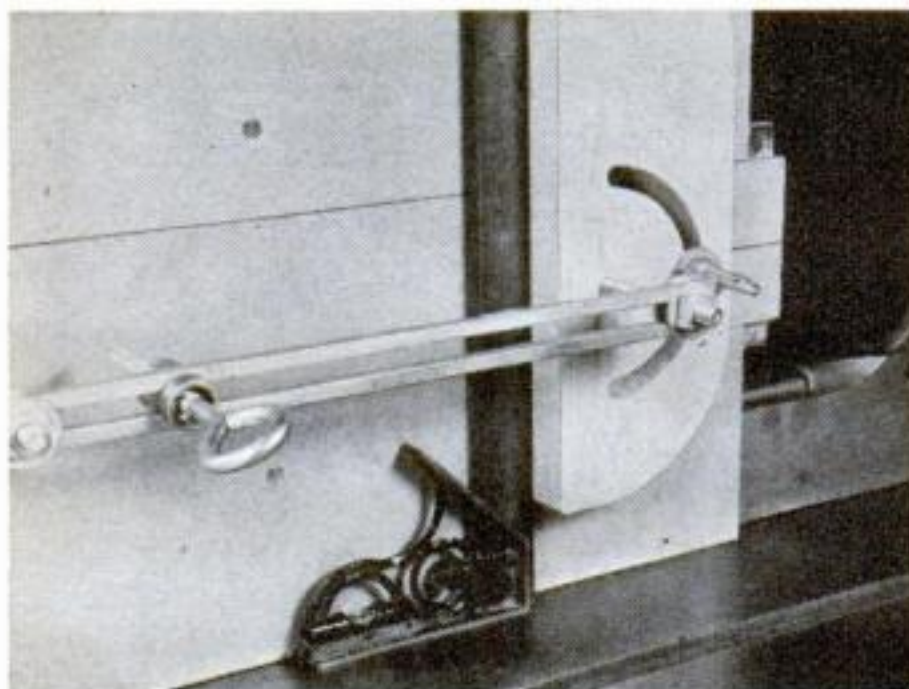
One clamp post is used as a pivot for the miter head, the underside of which is shown here. Be sure to counterbore pivot hole as shown to fit over the post's nut and washer.



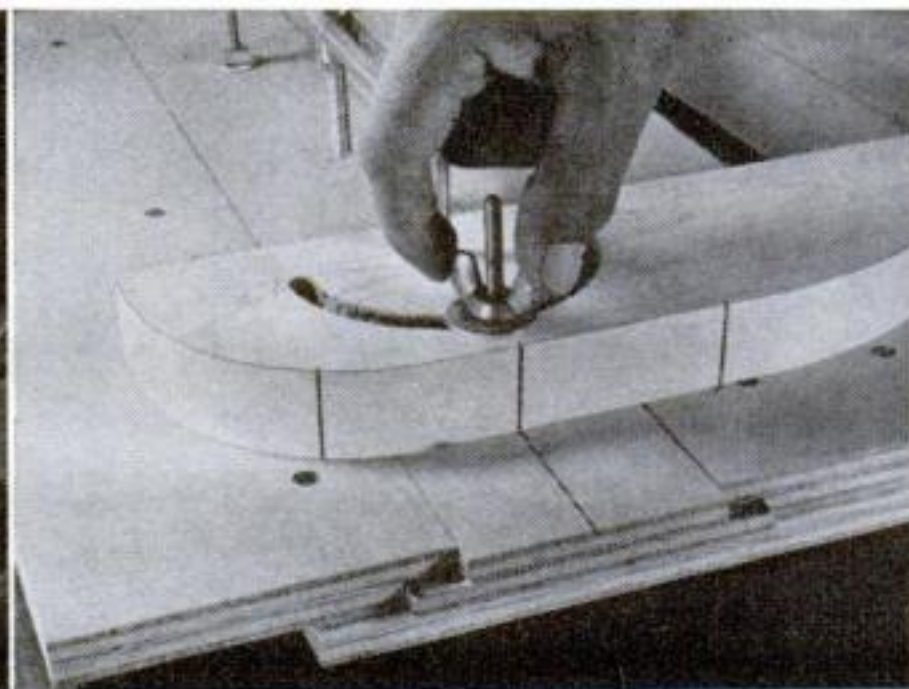
Level bars for clamp slide by adjusting the middle nut and washer on each post to the same height. Then set the bars on the washer, add top washer and nut.



Clamp slide is piece of steel tubing slotted with a file to fit the bars. File an eyebolt so it is just short of fitting inside the tube. Press it in place by squeezing in a vise.



If you mark the miter head and miter slide for frequently used angles (45, 90, and 45), do it so the angles are correct in relation to the table. Use square for the 90-degree setting, as shown.



Miter lock is made by cutting head from  $\frac{1}{4}$ " bolt and forcing wingnut beyond the threaded part of the shank. Note center mark in slide, and saw cuts in miter head, for angle settings.



them safely. You eliminate a changeover.

**Construction.** Plywood is okay but choose a good grade with a sound surface veneer. Hardboard-faced plywood was used on the one shown because of its smooth surface.

Although the jig was fitted to an Atlas 10" saw, the basic design can be suited to any other saw. Be careful of the setback at the base of the platform (the rabbet formed by the bottom miter-slide guide and the backup board). Determine this by the height of the rip fence; just a fraction less than the total rip-fence height is fine since you don't want the jig scraping the table when you position the fence.

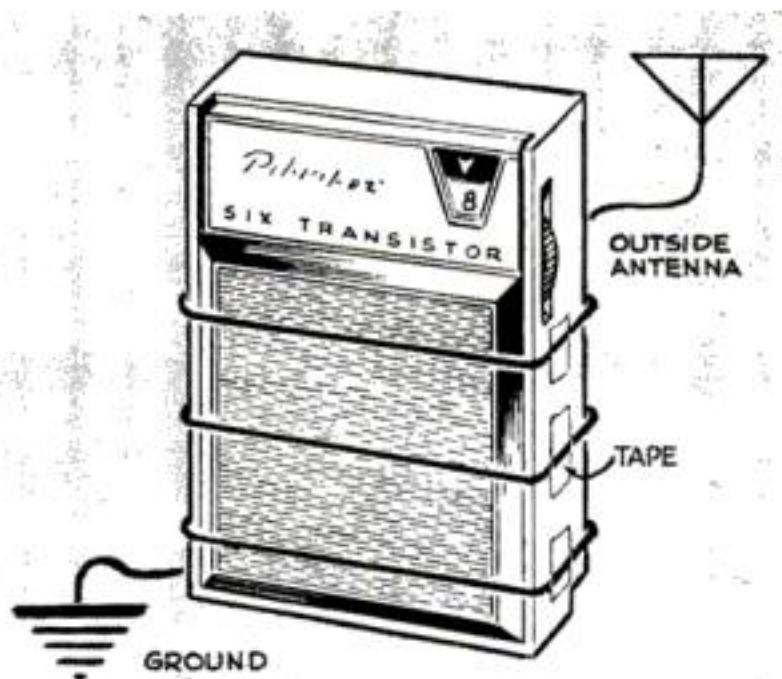
The top edge of the bottom slide guide must be parallel to the table surface. Best bet here (after rabbets are cut) is to clamp this piece in position against the fence and clamp the backup board to it while you drill for and drive home the screws that hold the two pieces together. Then you can remove the two pieces, put the miter slide in place, and screw on the top slide guide. This should be a fairly snug fit but not so tight that the miter slide won't move easily.

Mark a centerline on the miter slide and drill the two 5/16" holes for the clamp posts and the 1/4" hole for the miter-head lock. The 5/16" holes are counterbored for the nuts while the 1/4" hole is enlarged at the bottom to take the TeeNut.

**Put the clamp posts in place** and check the slide action in the platform. Now, with a straight-edge, make sure that the surface of the miter slide is at least flush with the surfaces of the miter-slide guides. Actually, it would be better to surface-sand the latter parts so the miter-slide surface is just a fraction higher. It can not be lower, because the eyebolt clamp must lock the work against the slide only.

Shape the miter head from a piece of clear pine. Drill the 5/16" hole for the clamp post around which the miter head pivots and then counterbore the underside for the nut so the head can rest flush on the slide. The semicircular groove for the miter lock can be shaped with a router on a drill press, or cut out on a jigsaw.

Sand all wooden parts carefully, especially edges and surfaces that must slide against each other, and give them a coat of sealer. Follow with another sanding, another coat of sealer, a rubdown with steel wool, and finally a well-rubbed application of paste wax. ■ ■

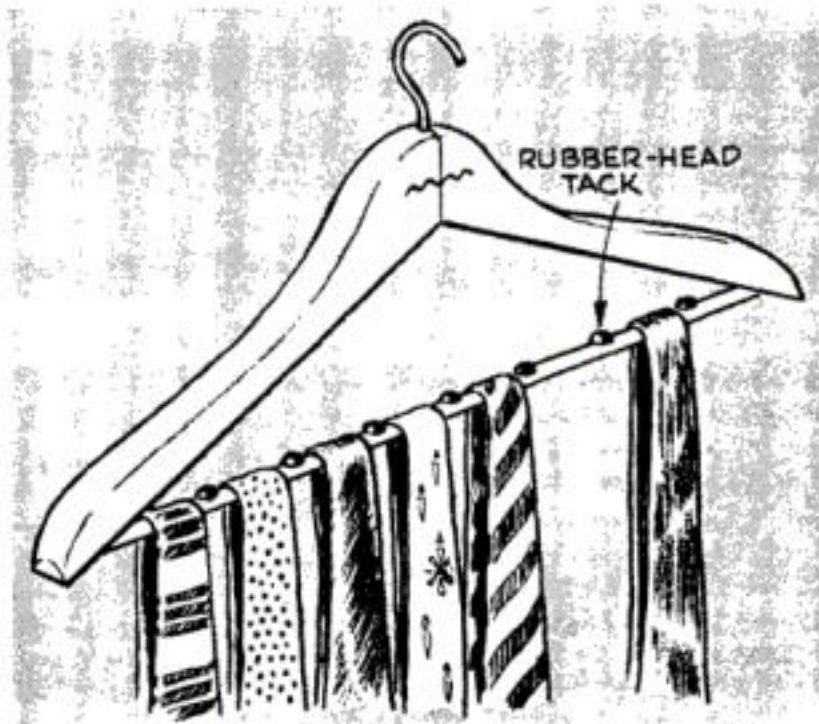


### A booster for portable radios

Wrap and tape from three to ten turns of small-gauge insulated wire around a portable and you have a booster. You can ground one end and let the other dangle—or connect it to another antenna. The trick permits reception inside such shielded areas as cars and ships, especially if the wire is led outside.—*J. J. Fowlston, Redondo Beach, Calif.*

▶▶▶ A professional painter gave me this good tip years ago for refinishing fine pieces of hardwood furniture.

Dampen fine (0) steel wool with lacquer thinner and clean the surface. After the surface has dried, rub it with dry steel wool. Finally, wipe it with a tack rag and clear varnish, either dull or glossy.—*E. L. Enochs, Modesto, Calif.*



### How to make a necktie hanger

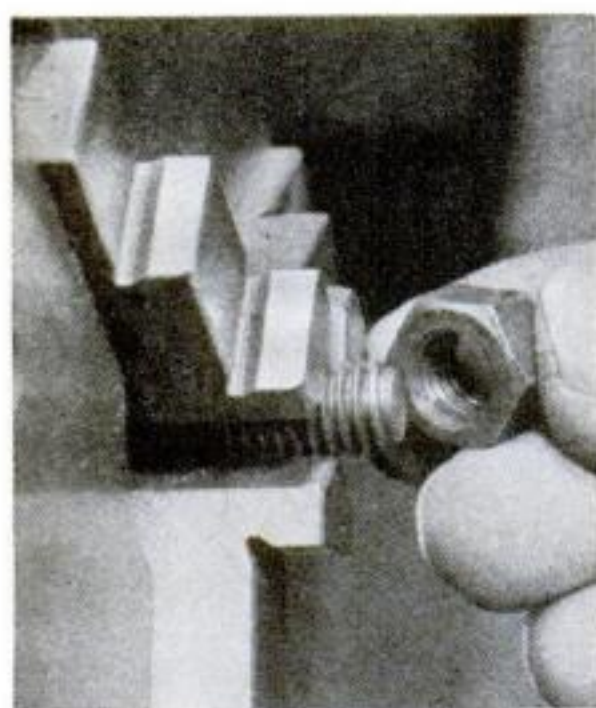
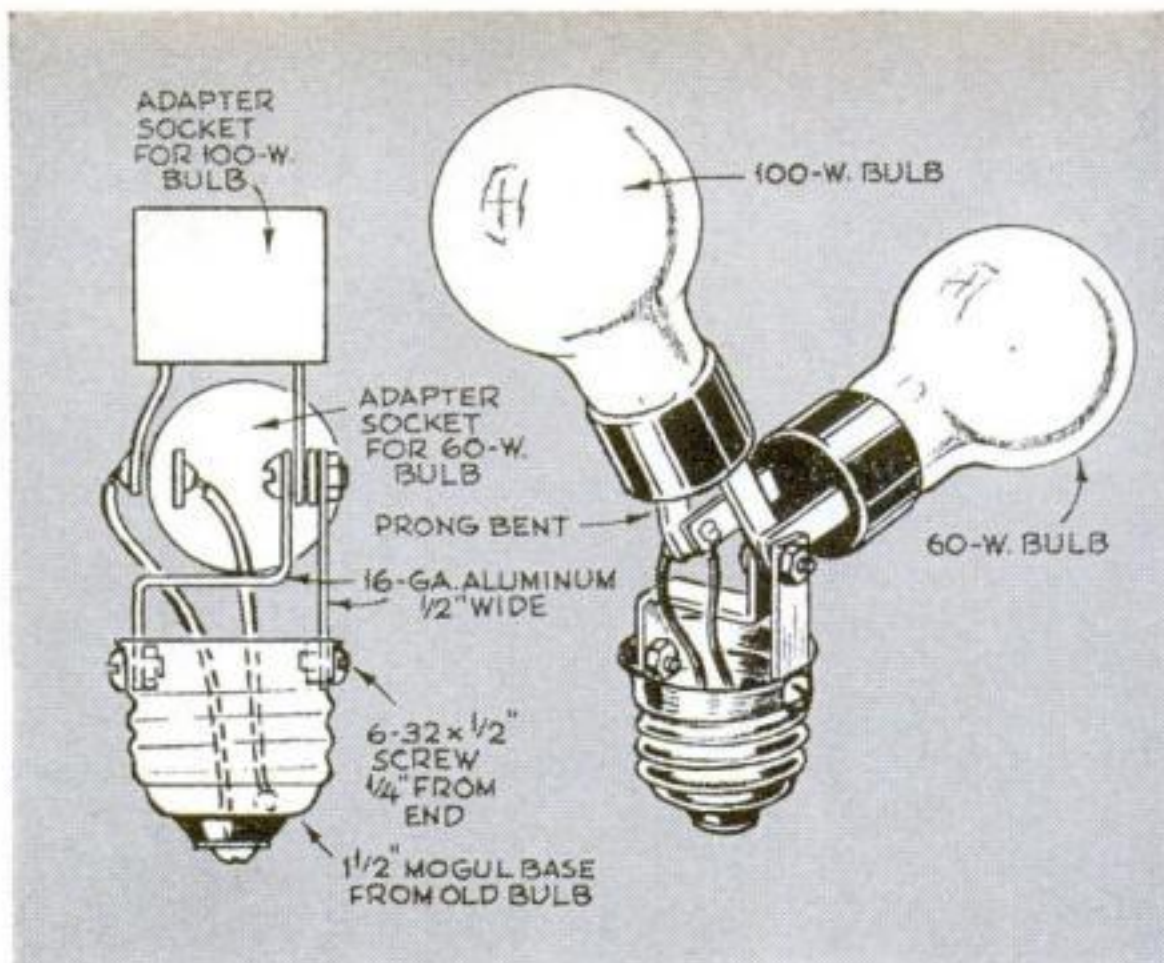
A wooden clothes hanger is easily adapted for use as a tie rack. Divide the rod into five or six even sections by pressing rubber-headed tacks into the upper side.—*Frank Shore, NYC.*



## Three-way lamp adapter replaces special bulb

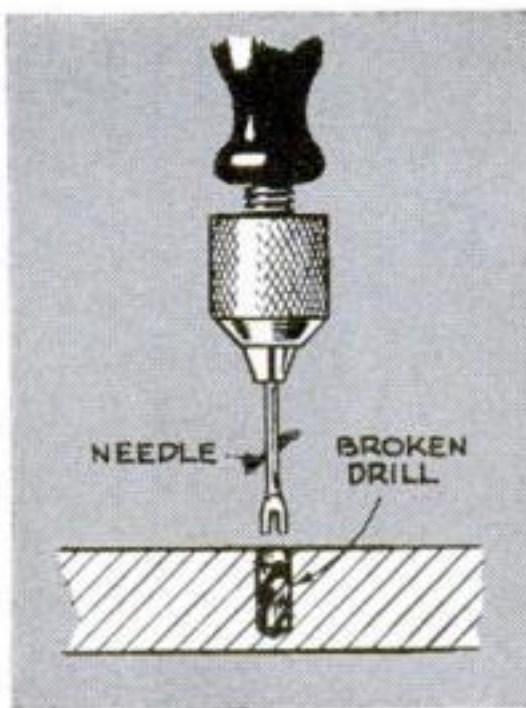
When the three-way 150-watt bulb in our floor lamp burned out for the third time in a year, I took my revenge. I wrapped a rag around the globe, smashed it, then tapped the remaining splinters out of the mogul base with a tack hammer. I clipped off the lead to the outer shell and soldered the outer two leads to the prongs of two plug-in sockets, mounted as shown. Screwed into the lamp, this adapter lets me use two standard bulbs that can be replaced individually—yet they give me

the three light levels of the expensive bulb: one click lights the 60-watt bulb; second click, the 100-watt; the third, both at once.—*F. H. Calvert, Kenosha, Wis.*



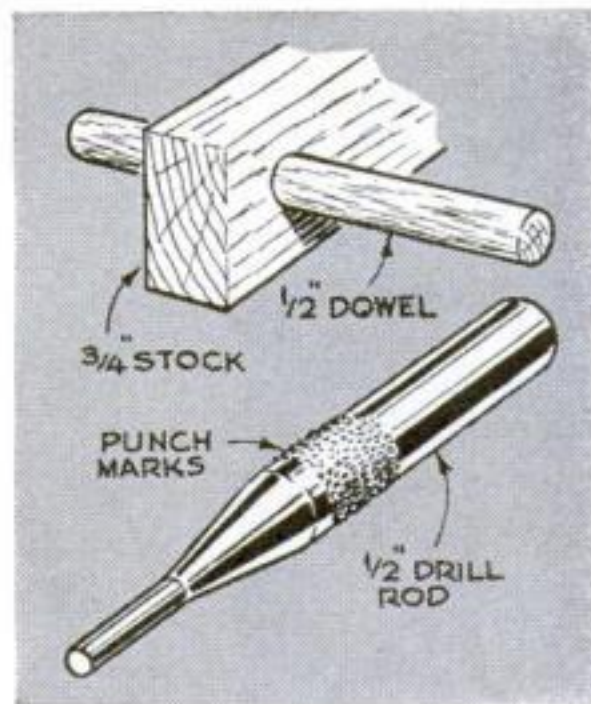
## Scrap bolts hold nuts for machining

When you shorten a bolt, don't discard the threaded section you trim off. A collection of such remnants is handy to keep around a metal lathe. If you want to machine a too-thick nut into a thinner one, select a bolt scrap with a matching thread and clamp it in a chuck so that it projects two or three thread turns. To use this as a mandrel for machining, screw the nut down tight.—*W. E. Burton, Akron, Ohio.*



## Needle retrieves a broken bit

Drilling into a large metal plate, I broke a small bit off below the surface. In search of something to fish it out with, I ground off the tip of a needle eye, leaving two prongs to engage the flutes of the broken drill. With the needle held in a small pin vise, I was able to back the stub out. This would work as well with a broken tap.—*Troy H. Main, Bartlesville, Okla.*



## Reamer for undersize dowel holes

It's not uncommon for dowels to be slightly larger than holes bored with a bit the same size. When you've got a batch of dowels to drive, sanding them down can be a chore. I spared myself by making a lot of punch marks to form a one-inch band around an old driftpin the same diameter as the dowels. Mounted in my drill press, this makes a fine reamer for tight holes.—*Harry Loudon, Sarasota, Fla.*



# A Bicycle Built for One and One-Half

WHEN I bought myself a bicycle recently, my three-year-old daughter didn't understand. I just wanted the exercise of some fairly hard riding, but each time I set off on a spin, she burst into tears at being left behind. Yet if I perched her sidesaddle on the crossbar, I didn't dare go fast. Both pedaling and steering were awkward. And (though she'd rarely admit it) she was far from comfortable.

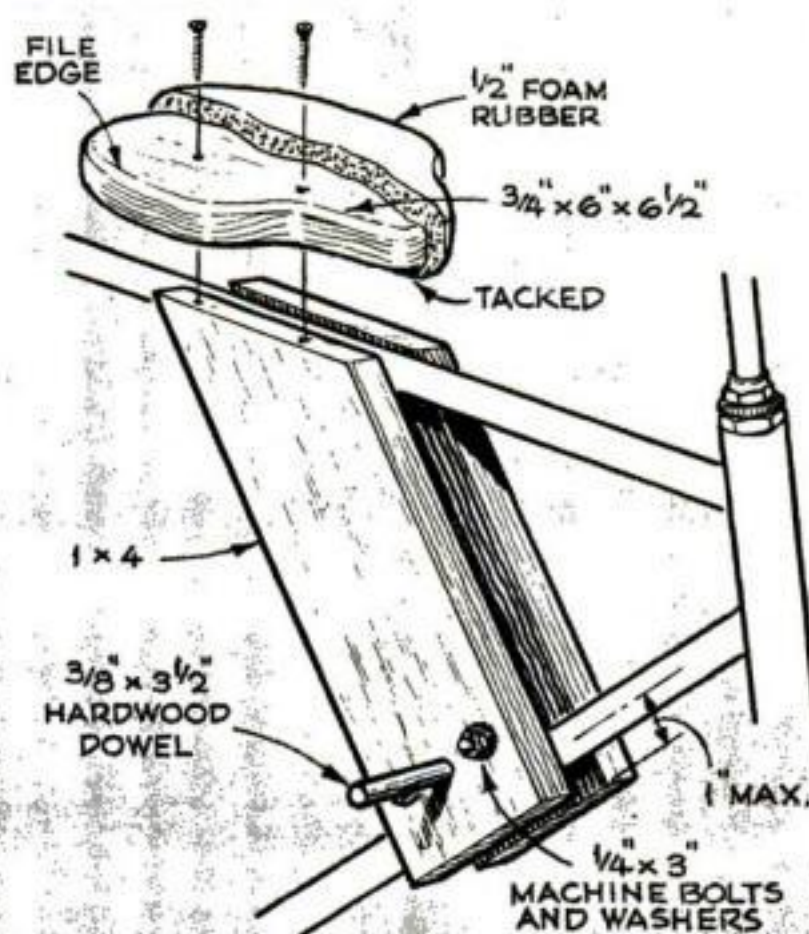
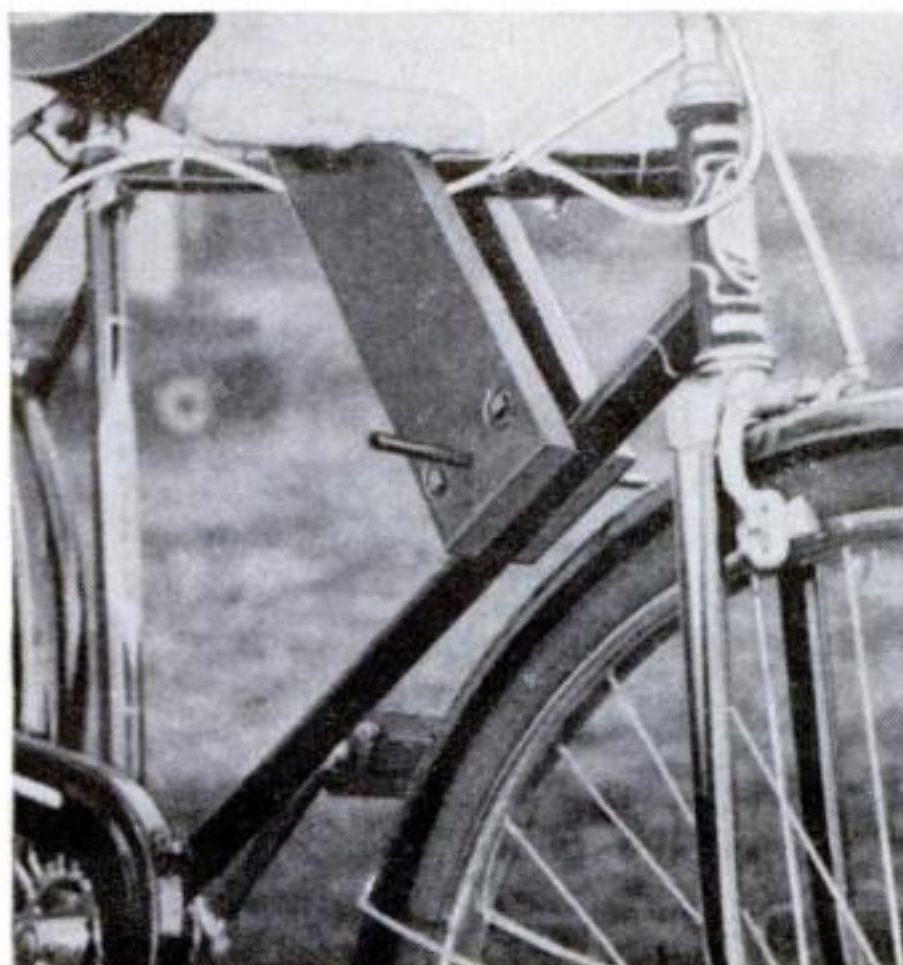
Then I designed a special seat for her. The construction is simple, and can be adapted to any boy's-type bike. I used scrap lumber for the side supports and seat board. Two 3" machine bolts join the supports and bear on the angled brace. If there's a tank below the crossbar, the supports will be wider apart, requiring longer bolts passed through a filler block. Projecting dowels serve as foot rests.

I painted the whole unit to match the bicycle. When attached, it doesn't interfere with pedaling, but it can be easily removed when not needed.

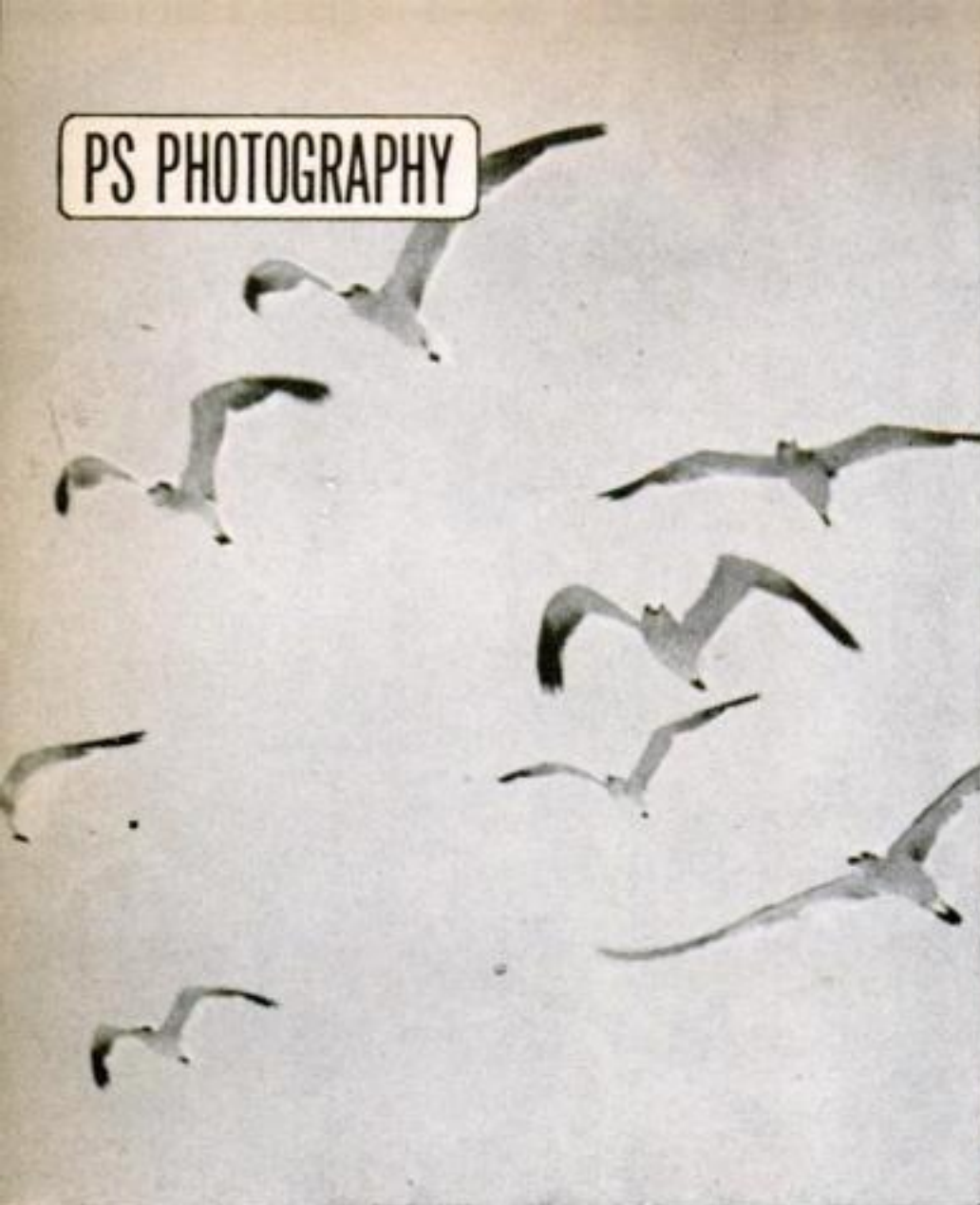
My daughter and I have taken many



pleasant cycling trips together. It's always a thrill for her, and I now find that I enjoy having someone to talk to while I'm getting my exercise and enjoying the passing scenery.—Charles R. Gray.







# Bring 'em up close with **A Big Bertha** **You Can Make**

By Otha C. Spencer

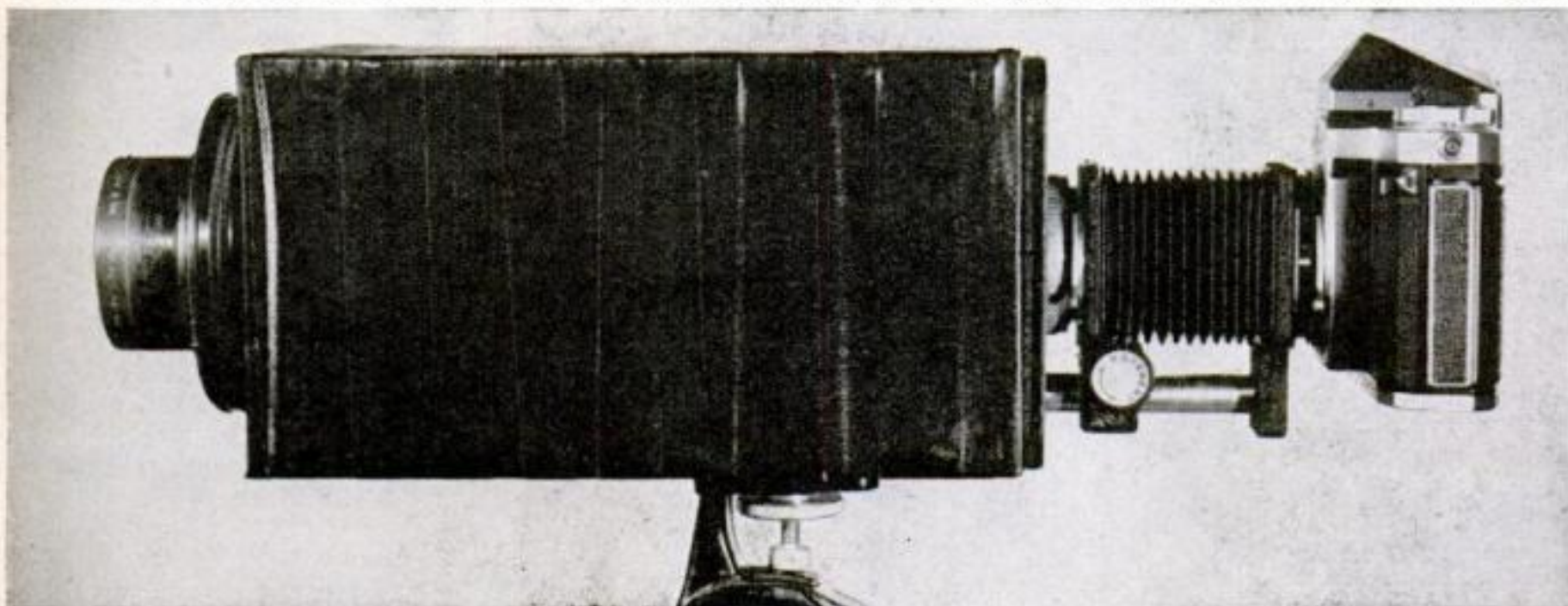
**I**F YOU'VE wistfully admired those "way out" photos—a close-up of an eagle's beak or the grimace of a cowhand throwing a steer—but have had to resign yourself to more prosaic pictures because of

the cost of a good telephoto lens, I have news for you. You can make these eye-popping pictures without bending the budget.

As any good photographer knows, the size of the image you get on the film at any given distance depends on the focal length

CONTINUED

A variation on the aerial rig is this 5"-square plywood tube designed for a shorter long-focus lens.





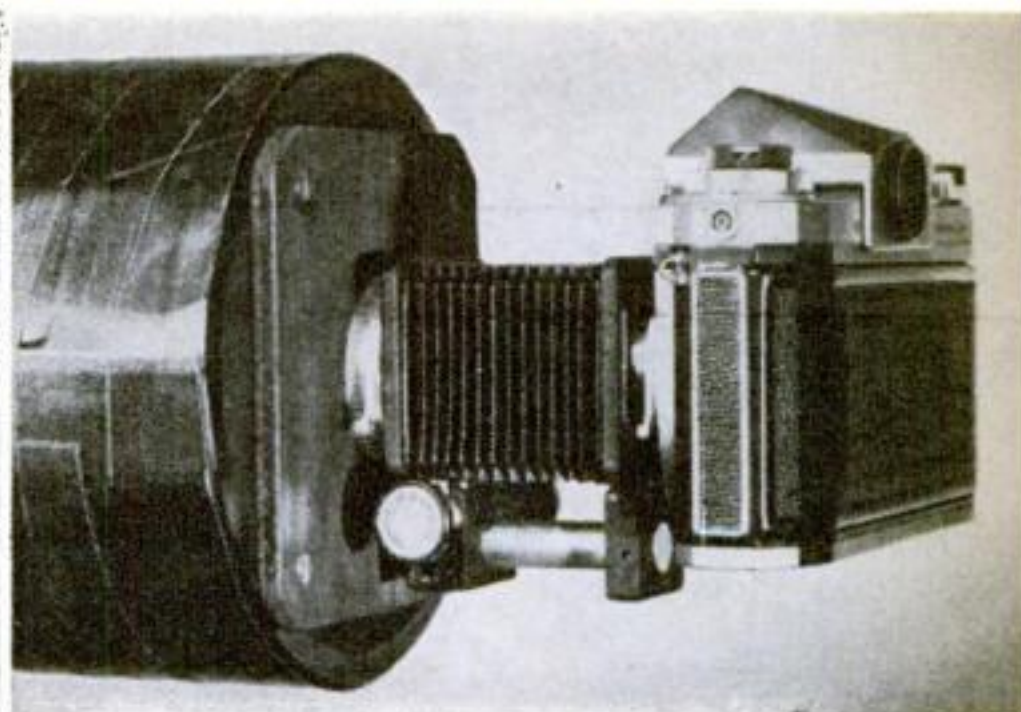
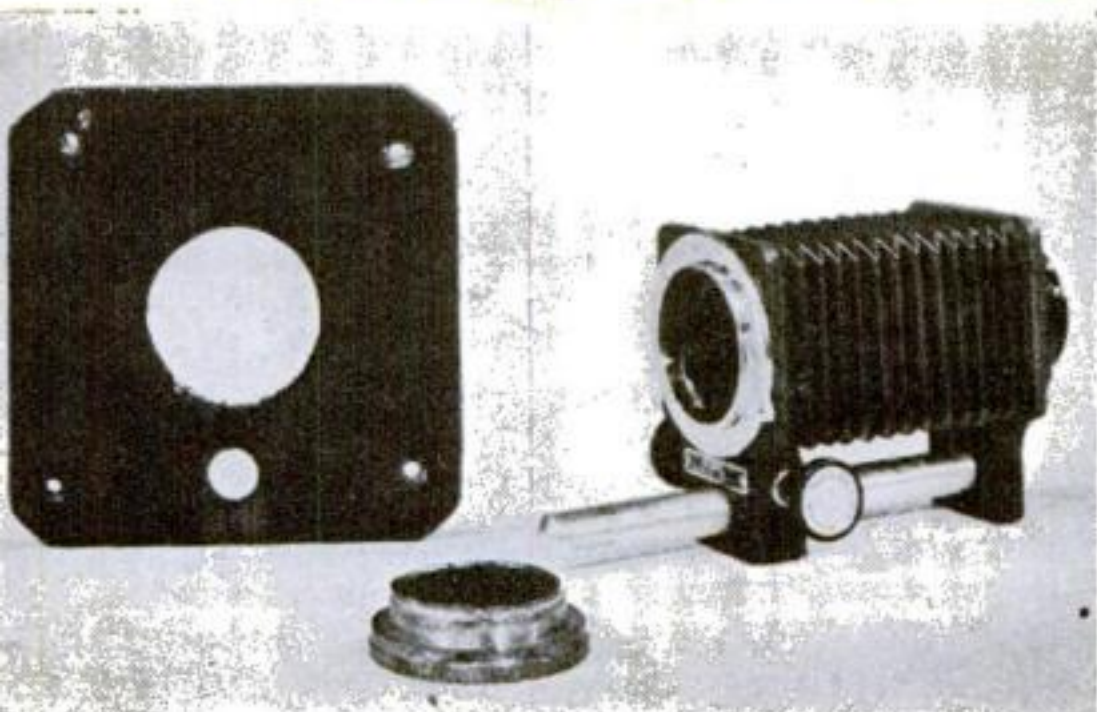


You're in the thick of things when you shoot through a long-focus lens. Shots of high-winged gulls or fall scrimmage, left, would have been impossible without a rig of this kind.

## One bellows serves many long-focus lenses

Focusing unit lets you adapt a 35mm reflex to all types of long-focus lenses. It consists of 4½"-square lensboard cut from ¼" plywood; an adapter ring that mounts over board's center hole; and a bellows accessory designed for your camera (about \$15 for 35mm models). Adapter ring can be secured to board with four

½" bolts placed so that heads clip over the flange, if flange is not wide enough to bore. Small hole in board lets focusing track pass through, has felt washer to prevent light leakage. At right, assembled unit is attached to aerial rig, shown above. At far left, same unit is mounted on shorter tube to serve a 12" lens.





of the lens. The longer the focal length, the bigger the image. A telephoto lens is a special kind of long-focus lens that squeezes the optics into a compact package. It's done by placing the principal point of the lens (the point from which focal length is measured) out in front of the actual lens assembly.

This kind of optical legerdemain is expensive. But if you're willing to put up with a more awkward package, you can get the same results for far less money. Used long-focus lenses can be bought cheaply—the surplus 24" aerial lens shown here originally cost \$1,200 but may sell for less than \$50.

## How to Find the Focal Length

You must know the focal length of any long-focus lens in order to determine how long the adapter tube should be. This number should be stamped on the lens barrel—in millimeters, centimeters, or inches, depending on the manufacturer's system. If it isn't, you can find it by focusing the rays of the sun to a burning point behind the lens and measuring from this point to the center of the lens.

Technically, focal length is the distance from the lens center to the film (focal) plane within the camera when the lens is focused at infinity.

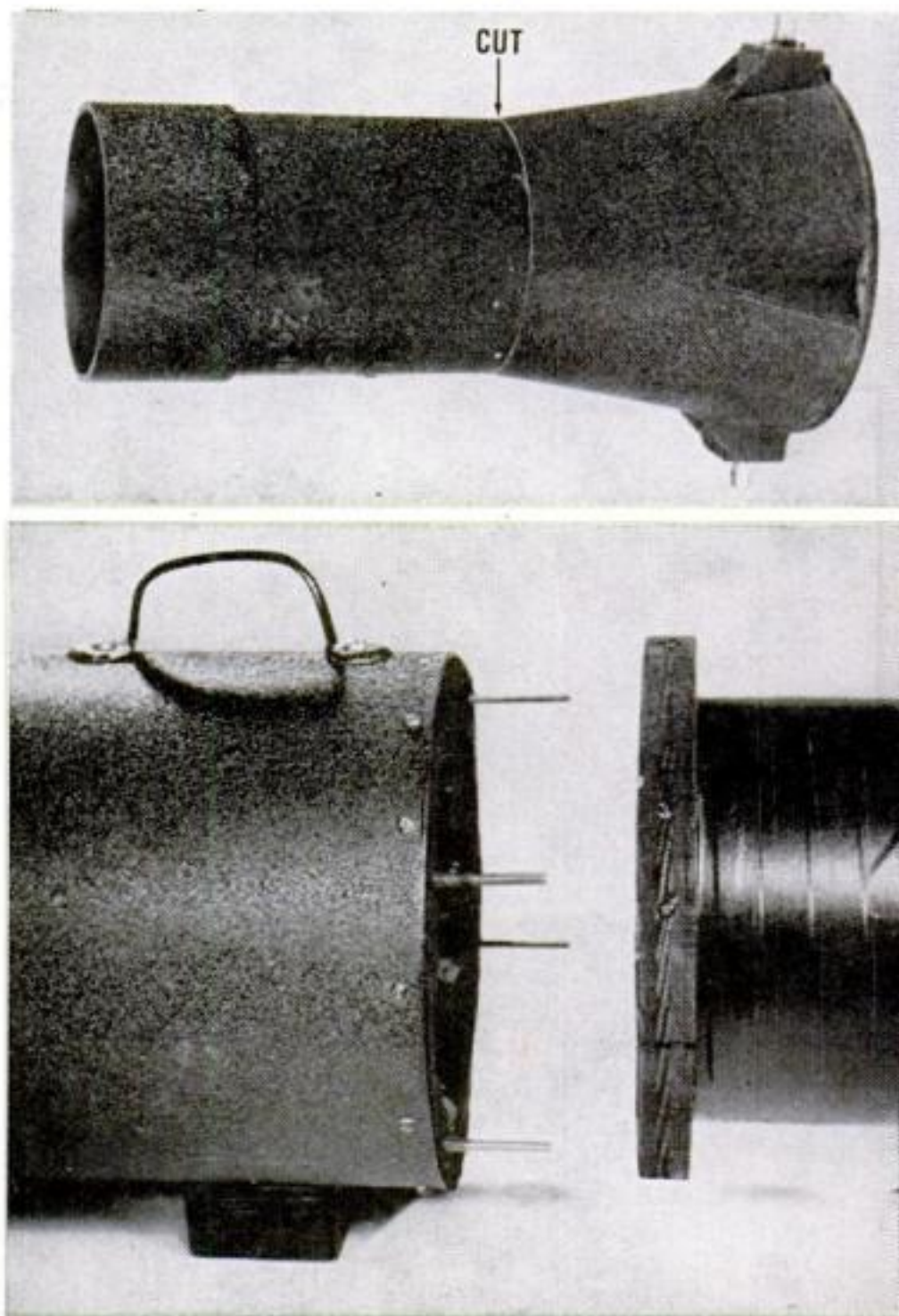
Here's how to build a practical adapter that can fit such lenses to a 35mm single-lens reflex. That's the ideal camera for this work—although a variation of this adapter can be made for 2¼-by-2¼ single-lens reflex or 4-by-5 press cameras. In fact, any camera with a focal-plane shutter and ground-glass or reflex focusing can be fitted to this adapter.

*There's a neat trick* to adapting several lenses to a camera without making a complete adapter for each: You design a bellows-focusing unit that can be quickly attached to any of several lenses. A bellows lets you focus the various lenses through the camera view finder.

Since the distance from the homemade lensboard to the focal plane is about 4" with the bellows fully compressed, the lens tube should be 4" shorter than the focal length of the lens. This brings objects at infinity into focus. As the camera-to-subject

## This super-length lens splits in two for easier carrying

War-surplus aerial lens is easily adapted to telephotography. The one shown at right has 24" focal length, so one-piece tube would be unwieldy. Front half is original lens housing with cone flare cut off (photo below). Sketch gives overall dimensions which can be adjusted for lenses of other focal lengths.

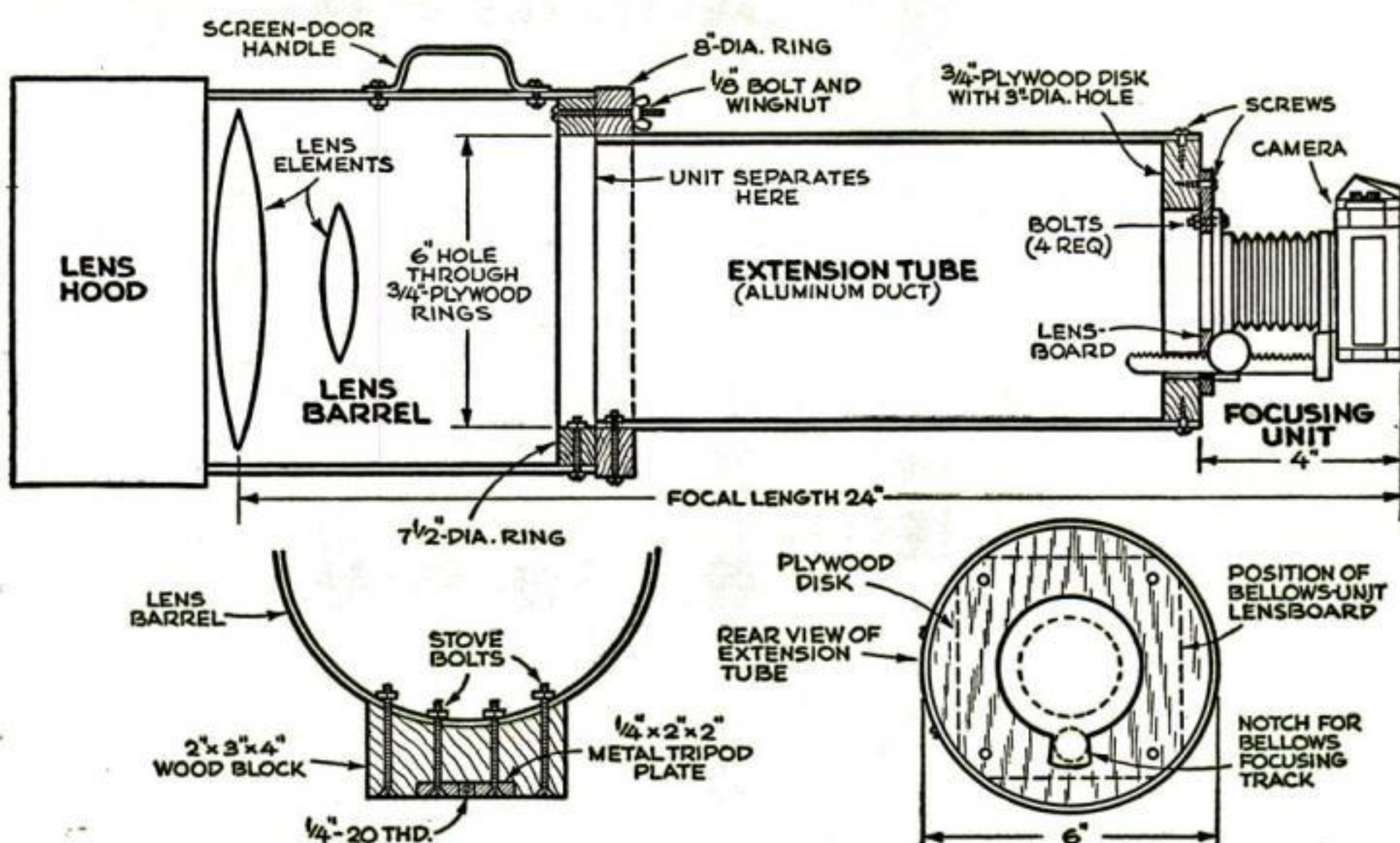
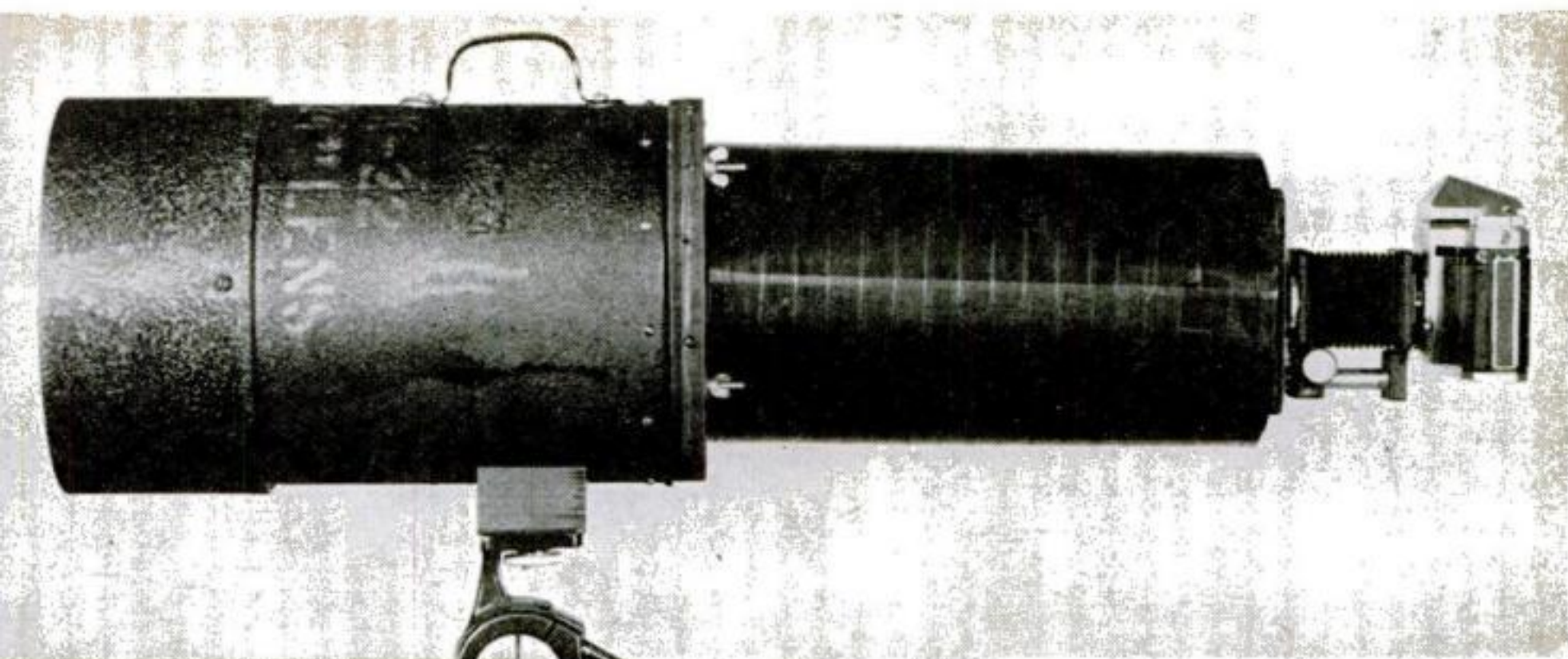


Halves are joined with four bolts through plywood ring inside trimmed-off barrel (above). These pass through holes in ring around extension tube. Black plastic electrician's tape seals

distance decreases, the bellows can be racked out to adjust for proper focus.

On the facing page, the focusing unit is shown mounted on a two-piece tube for the 24" aerial lens. Half of this tube is the original lens housing, cut down. These housings are aluminum, so they're not hard to cut; and since the optical elements are up front, you don't need the bulky cone section. The cut, however, should be perfectly square. (Lenses of less than 18" focal





joint between ring and tube. Unless seamless, wrap entire tube with tape (lapping  $\frac{1}{4}$ " ) to lightproof it. Mounting block, shown in photo and sketch, is shaped to fit lens barrel and

bolted at balance point, with tripod plate recessed in bottom face. Rear plate (sketch, right) fastens inside extension tube to provide means of attaching lensboard, bellows, and camera.

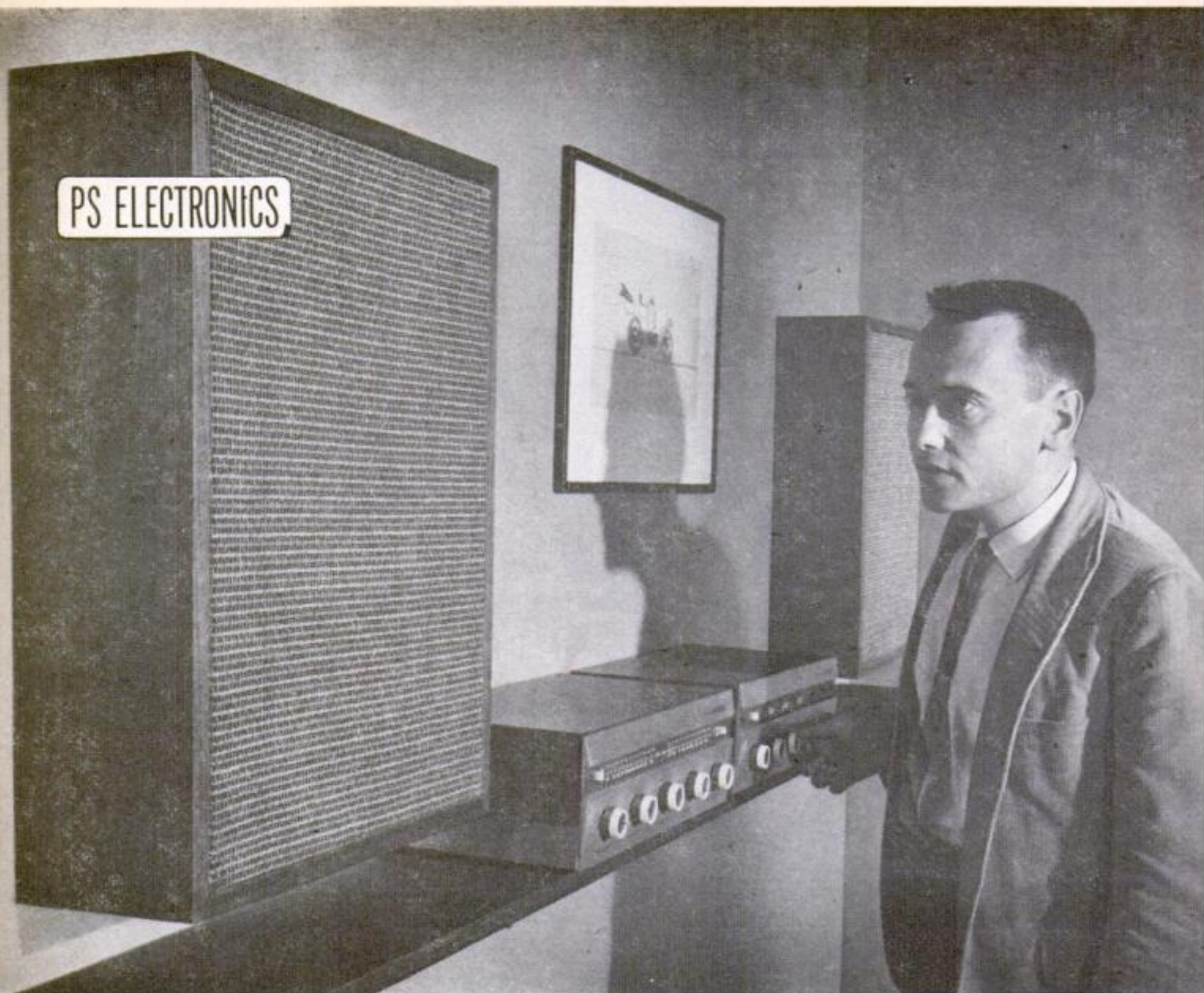
length don't require this break-apart feature for portability.)

For a snug fit, the plywood piece that slips inside the cut barrel should be turned on a lathe. Then a 6" hole is cut in the center. This ring is fastened in place with  $1\frac{1}{2}$ " bolts through  $\frac{1}{8}$ " holes drilled through the barrel, spaced every couple of inches around the rim. The extension-tube ring is similarly fastened, but this time the tube slips inside the center hole. Use a foot-

long piece of 6" aluminum tubing (such as heating duct). To make the coupling light-tight, felt rings are glued to the meeting faces of the two rings. Wood parts, and the inside of the extension tube, are painted flat black to kill reflected light.

Long-focus lenses can't, of course, be used on a hand-held camera. They must be mounted on a sturdy tripod. Even slight movement, magnified by the great distance, will produce a blurred negative. ■ ■





Less than \$40 buys the makings for one of these

# Space-Saving Wall-Hung Speakers

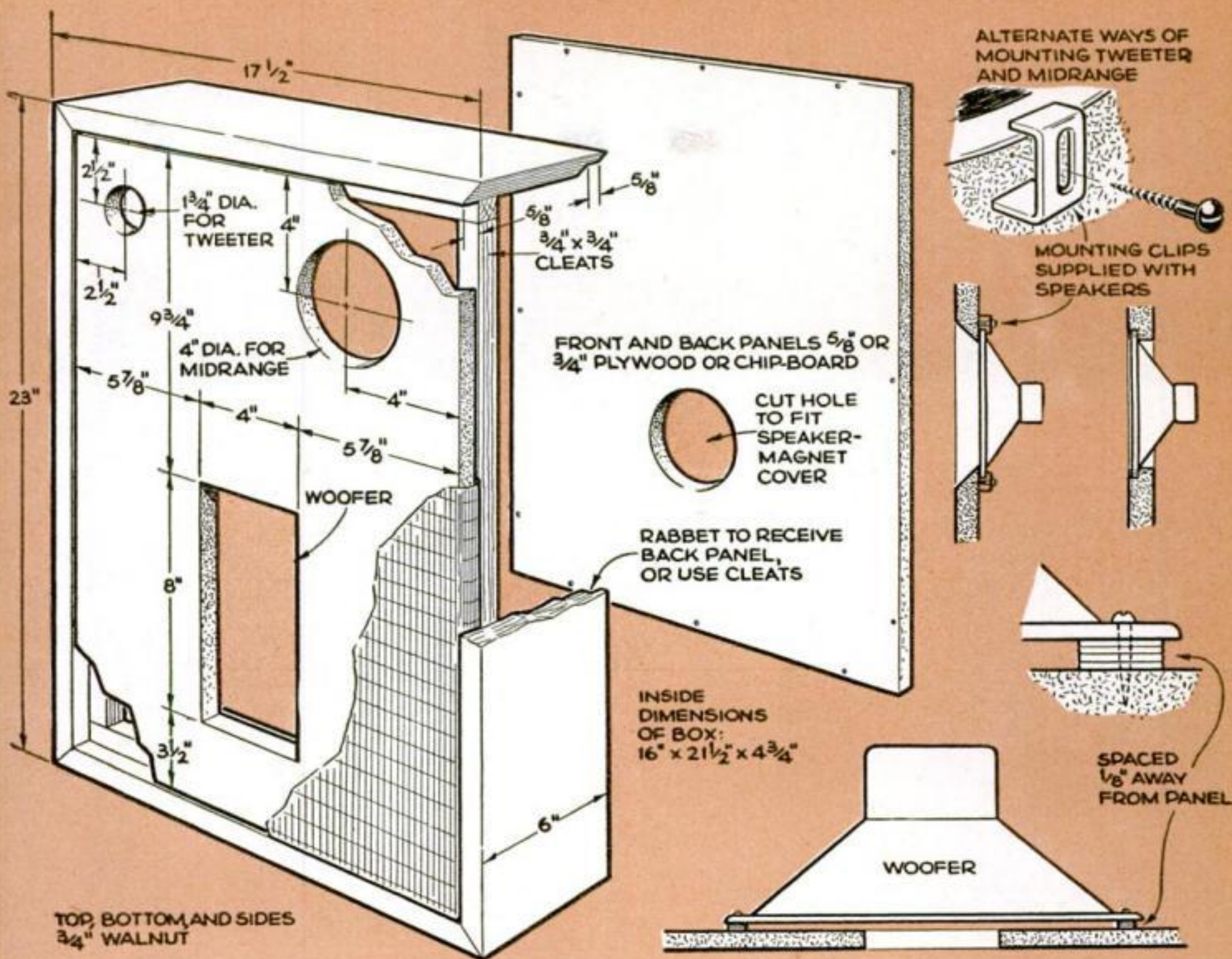
By Dave Gordon

"**E**ITHER I or those two packing crates you call loudspeakers will have to go." My wife's ultimatum, after she'd tolerated my "temporary" speaker enclosures for two years, seemed unreasonable, to say the least. But her next remark was outrageous to anyone who knows anything about hi-fi speaker enclosures:

"If you want to have stereo in my new living room, I want the speakers about this size," she said, pointing to a framed Modigliani print, "so I can hang them on the wall like a picture."

When I heard that ring of tempered steel in her voice, I knew it was pointless to try to explain about technical details. She had no interest in the enclosed volume you need for good bass, how far the speaker magnet juts out, or that the middle of a flat wall is, acoustically, the least desirable location for a speaker. My





job was to get around all this. I groaned.

First I had to solve the purely mechanical problem of getting the speakers to fit into an acceptably shallow box. The magnet on a 12" speaker extends at least half a foot from the mounting face.

**Stealing a trick.** I borrowed a design idea from the TV makers and let the magnet stick out through a close-fitting hole in the back. The depth saved promised a fairly trim appearance for a wall-hung box, but the problem of getting good sound wasn't so easily solved.

Using the standard bass-reflex technique, I found that any box with less than three cubic feet enclosed volume sounded muddy and boomy. The bass tones were badly distorted. I tried every trick I had ever heard of: tuning ducts, resistance loading, completely filling the box with sound-absorbing material. I ran response curves on each one and carefully adjusted them for

best results. But the sound from none of these pleased me.

Many experimental models later, I found the answer. The precise physical arrangements used are so novel that I have made application for a patent. (There is no objection to *your* building one for personal use, but you can't copy the idea to build speakers for sale to others.)

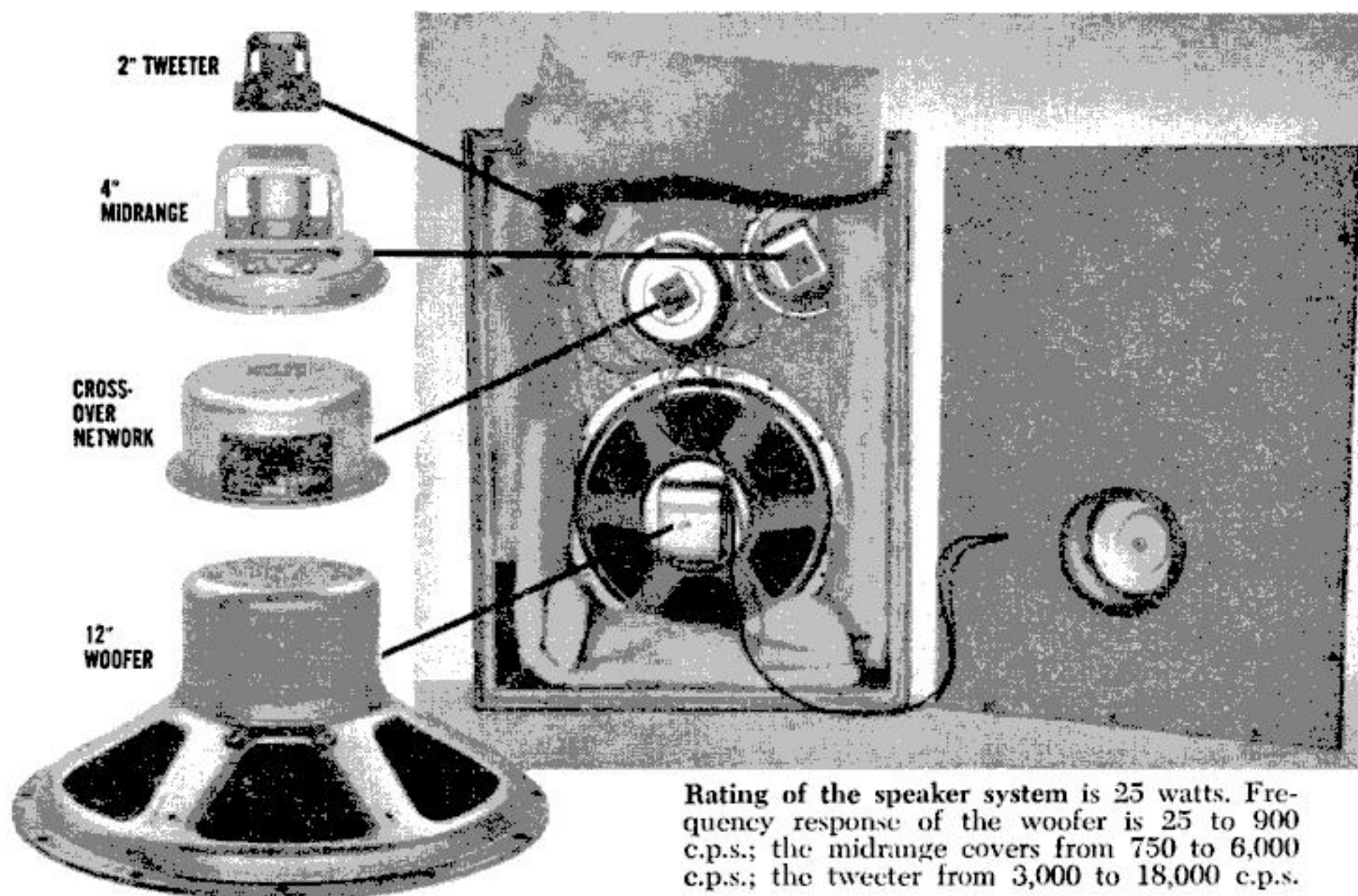
The three speakers and crossover I used are an excellent, inexpensive, imported set that sound far better than you would expect at their under-\$30 cost.

Three of the major mail-order houses now stock the set although they are not yet listed in their catalogues. You can order from these stock numbers: Lafayette, Copenhagen 3-25; Olson, AS-733; Radio Shack, 40K1111.

Other speakers may work as well as those specified, but to get equal results you would need the knowhow and test



## You'd expect a speaker system in an enclosure this small to



Rating of the speaker system is 25 watts. Frequency response of the woofer is 25 to 900 c.p.s.; the midrange covers from 750 to 6,000 c.p.s.; the tweeter from 3,000 to 18,000 c.p.s.

equipment to adjust the enclosure for a different woofer.

**Building the box.** Butt joints work as well as any, but if you have the tools to make fancier joints, go to it. In any case, the inside dimensions must not vary from those shown. Assemble the four 6" side panels first. If you have enough bar clamps or make a clamping jig, you won't need screws or nails—glue will hold them. After the glue sets, install the cleats with nails and glue.

Cut the front-panel speaker openings as shown. It's better to mount the midrange and tweeter flush with the front of the panel, but if you don't have a router to cut the necessary recess, you can mount them from the rear. In this case, the cut-outs should taper as shown.

The rectangular woofer opening must line up with the circular cutout (for the speaker magnet) in the rear panel. First cut the rectangular hole in the front panel; then clamp the panels together and lay out the round cutout on the rear panel so it is centered in the rectangular opening.

Mount the midrange, tweeter, and crossover with roundhead wood screws.

Wrap grille cloth tightly around the

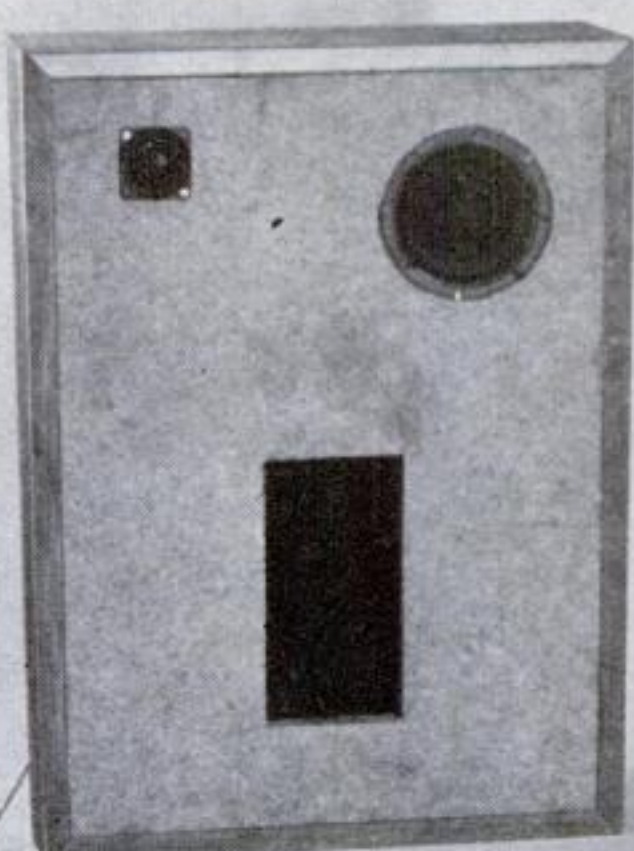
front panel, leaving a 1" overlap. Tack or staple the cloth to the back of the panel. Attach the front panel to the frame with screws through the cleats from the back. Use plenty of glue on mating faces to insure an airtight seal.

Cut the hole for the woofer magnet in the rear panel. Place the cabinet face down on a cardboard-covered surface (to protect grille cloth) and center the woofer over the rectangular cutout. Fit the hole in the rear panel over the speaker magnet and shift the woofer as needed to let the panel seat against the cleats. Lift off the rear panel, being careful not to move the speaker. Mark the exact position of the speaker. Drill pilot holes for mounting screws. Mount the woofer with the washers in place to give the exact spacing ( $\frac{1}{8}$ ") shown in the drawing. This spacing is the key to the performance of this system. It was determined for the specified woofer by much trial and error, and should not be varied.

When the speakers and crossover have been wired and you are sure the rear panel fits properly, install the glass-wool damping material. Here's where a special feature of the system shows up: You can



sound terrible—but you'll change your mind when you hear it



The crossover points are 750 and 4,000. Impedance is eight ohms. You can use ordinary twin-lead lamp cord, or any other 18-gauge insulated wire, to connect the speakers. (A large

wiring diagram comes packed with the speakers.) If your cutout for the woofer magnet does not fit snugly, force a piece of felt weatherstripping into the crack before you fill it with epoxy.

easily adjust the bass output to your own taste. With a 3" thickness of glass wool tacked loosely to all interior surfaces, the response is smooth and nonresonant, with emphasis on the highs. With no padding, you get a juke-box sound with a strong bass beat. To my ear, you get the best sound with a 1" layer fastened loosely to one side, the bottom, and the rear panel.

Use flathead wood screws (#8 by 1½") spaced about 4" apart to fasten the rear panel in place. Force epoxy glue into the crack between the woofer magnet and the rear panel to insure an airtight seal. If you ever need to remove the rear panel, simply unscrew the machine screw in the center of the magnet cover and the cover comes off with the panel. ■ ■

## Notes from PS' Technical Editor

*I have tried a pair of Mr. Gordon's speakers in my own living room. I found they give a big sound—far out of proportion to their tiny size. The highs and midrange tones are clean and crisp. The bass is full and musical. They don't reach all the way down to the lowest pedal tones of a pipe organ, but for most music you'll never know the difference. They'll handle all the power you'd ever want for normal, living-room listening. On-the-wall locations produced excellent stereo. Their flexibility—you can hang 'em anywhere for the best stereo effect—more than offset the slight gain in bass response you might get with more conventional placement.—Hubert Lockett.* 🗣️ 🗣️



Offbeat design  
is down-to-earth

# Building a Platter Plane

The model is designed to permit adjustment during nonpowered test flights. The tabs



By Roy L. Clough Jr.

**T**HE people who design full-scale aircraft ought to take a look at this Platter Plane. It's practically all lifting surface. The design can support a lot of weight, promising a big payload. The model is fast in flight, but drifts down slowly when the motor quits.

It's simple to build, and you can use a wide range of midget motors—from .049 to .15. You'll find plenty of room for radio control. A simple rudder control is all you'd need.

Construction begins with the oval frame that gives the platter shape. It's built up of medium-hard  $\frac{1}{8}$ " sheet balsa. Make a layout on a piece of hardboard or insulating board. Cover it with wax paper to prevent sticking when the outline is assembled. When the outline is thoroughly dry, add the ribs and spar. True it up, and when the glue sets, install the cross stringers and motor stalk. Cov-







on the double tail, and the elevator between, are attached with wires so they can be easily bent.

er the front section with sheet balsa.

The basketweave strips are added after the basic structure is complete. It's not necessary to set these strips in flush to the surface at the crossover points, but the job will be a little smoother if you take the trouble to do so. Install the fins, trim tab, and elevator next.

Covering is medium-weight gas-model tissue. Water-shrink it and lay on two coats

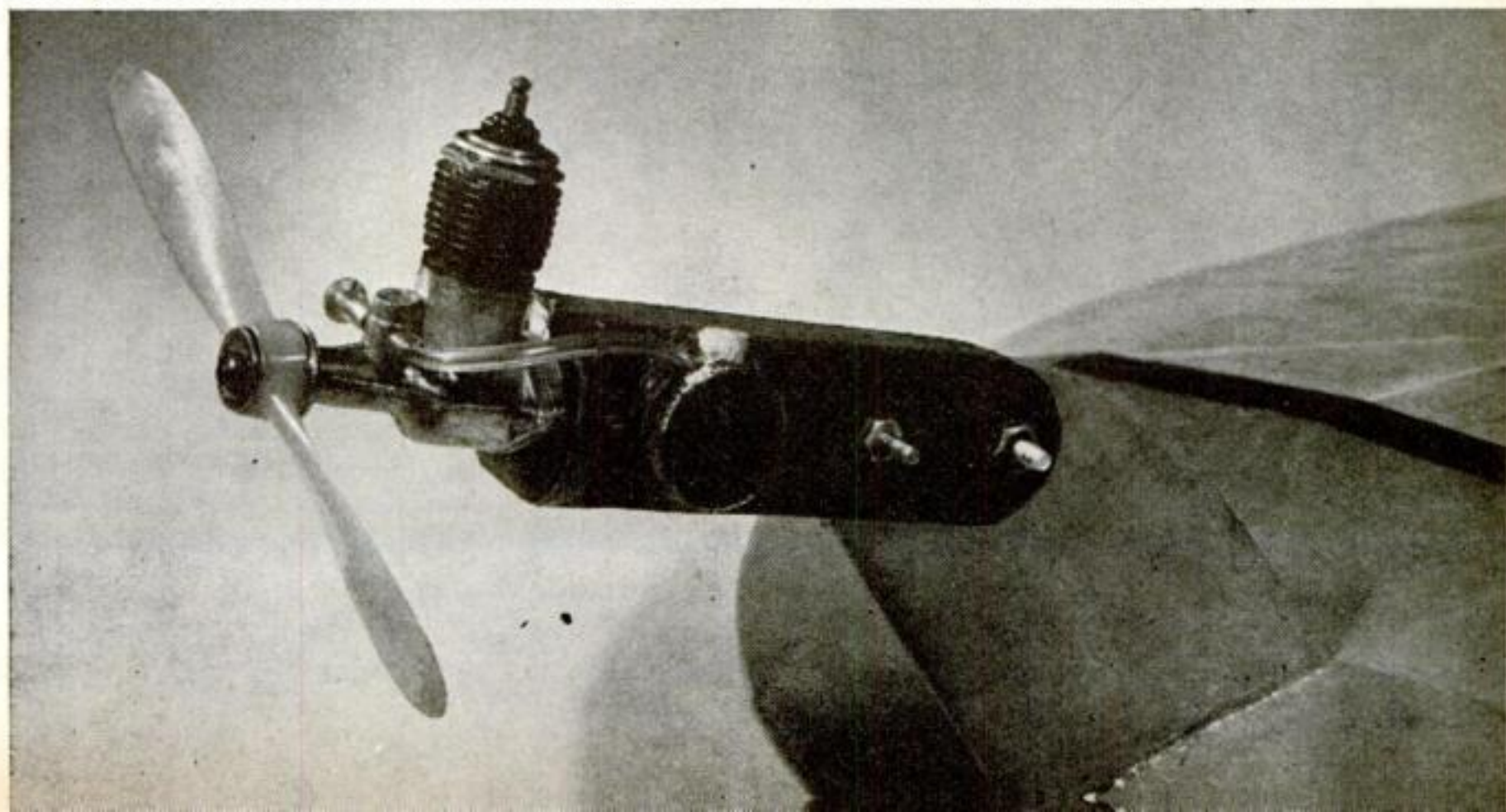
of clear butyrate dope. The front, sheathed section may be doped bright red to increase visibility in flight.

The motor mount is made up of  $\frac{1}{4}$ " pine or plywood and is attached to the stalk with a couple of 4-40 bolts. Later, after flight trim is established, this may be cemented in place. Note that the model is to be ballasted to bring the balance point about  $\frac{1}{4}$ " ahead of the spar. Cut a small hole in the

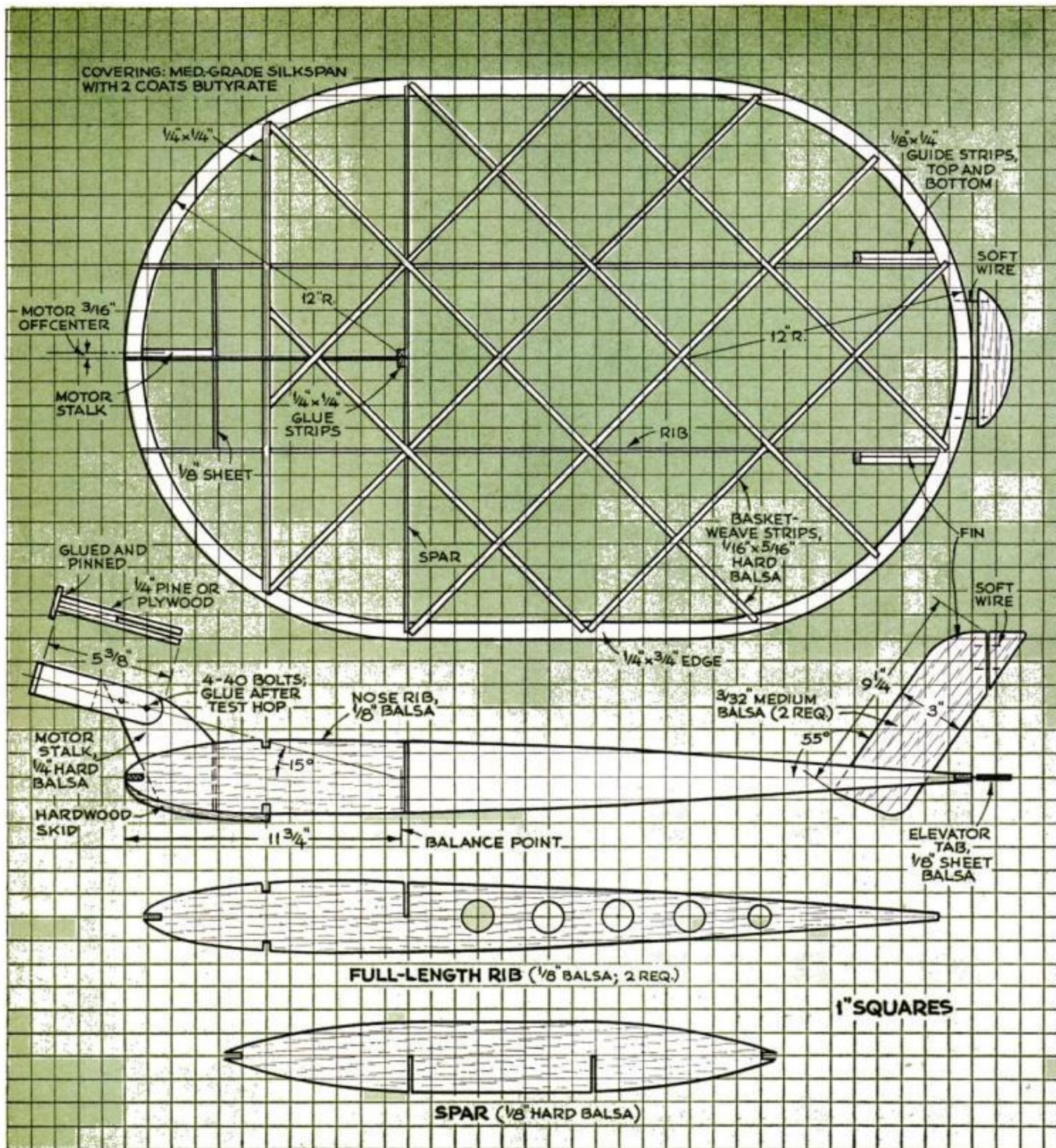
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The motor mount adjusts, too. It's bolted to a stalk projecting from the nose sheathing. After

a brief powered flight, you can angle the thrust line for the proper degree of climb.







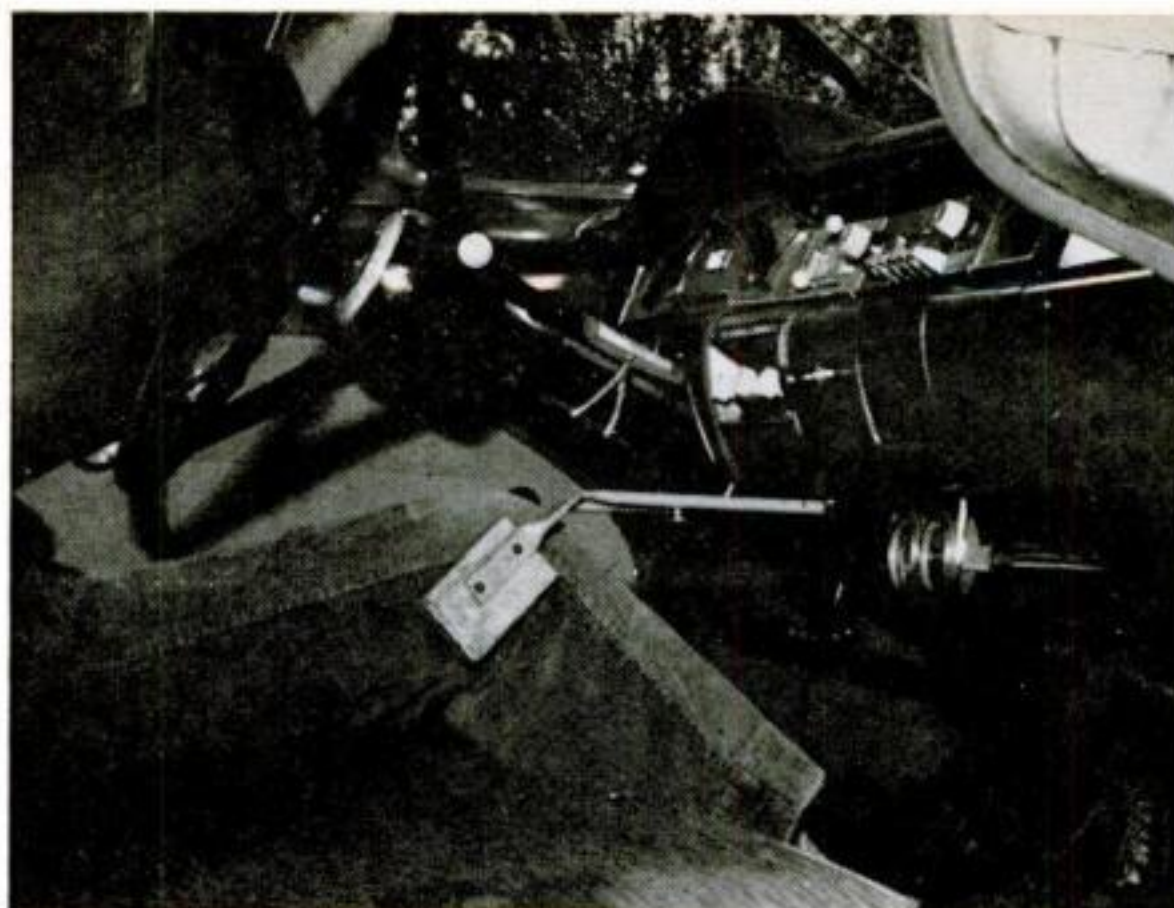
sheet-balsa covering at the foot of the motor stalk to add the ballast. How much will be used depends upon the motor weight. In any event, don't try to fly the model with the balance point aft of the position indicated on the profile sketch above.

Very simple to adjust, the model nevertheless needs attention to a couple of important details for maximum performance. First, adjust the ballast and elevator settings so that when you shoot the model forward, it moves out straight in a settling glide with

no tendency to oscillate from side to side. When you finish with this adjustment, the elevator must have a slight positive, or nose-up, effect. If it doesn't, the model may dive under power.

Next, try a powered flight of brief duration. Adjust the thrust line upward until the model climbs at the desired angle, then cement and tighten bolts in place. The model should roll to the left under power and climb in 100-foot circles, settling gently to earth when the motor stops. ■ ■



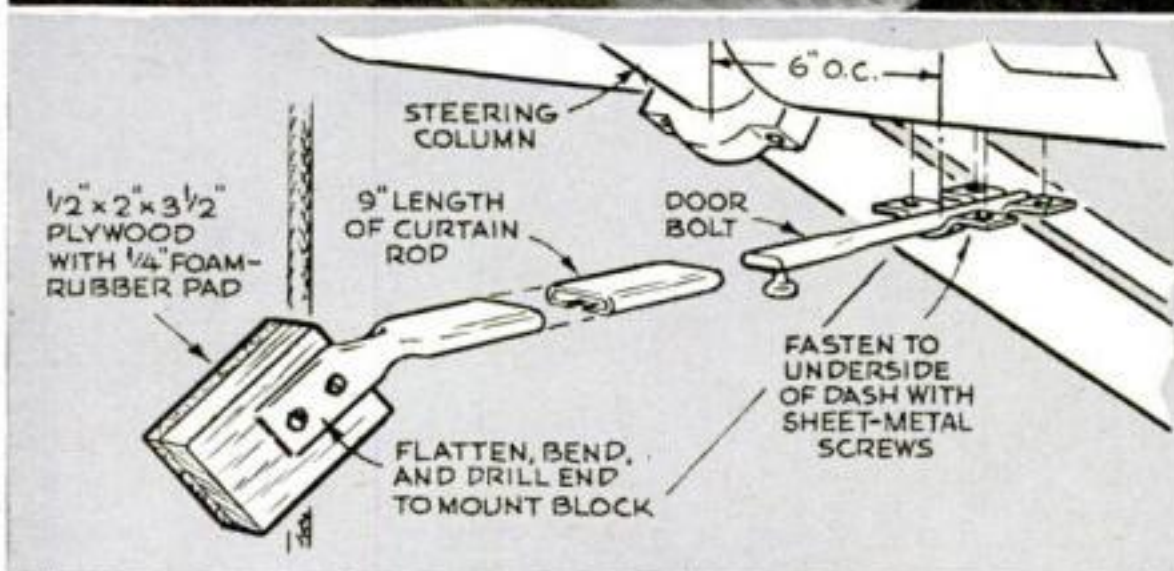


## Retractable knee rest prevents driver's cramp

On long trips, the steady pressure of your foot on the accelerator can set up a cramp in your unsupported right knee. After trying out a friend's low sports car, where I could lean my leg against the big drive-shaft tunnel, I designed this brace for my '58 Ford. It takes some of the strain off the knee joint and can be adapted to any car—or driver. The curtain-rod shank can be angled to place the pad where it's most comfortable.

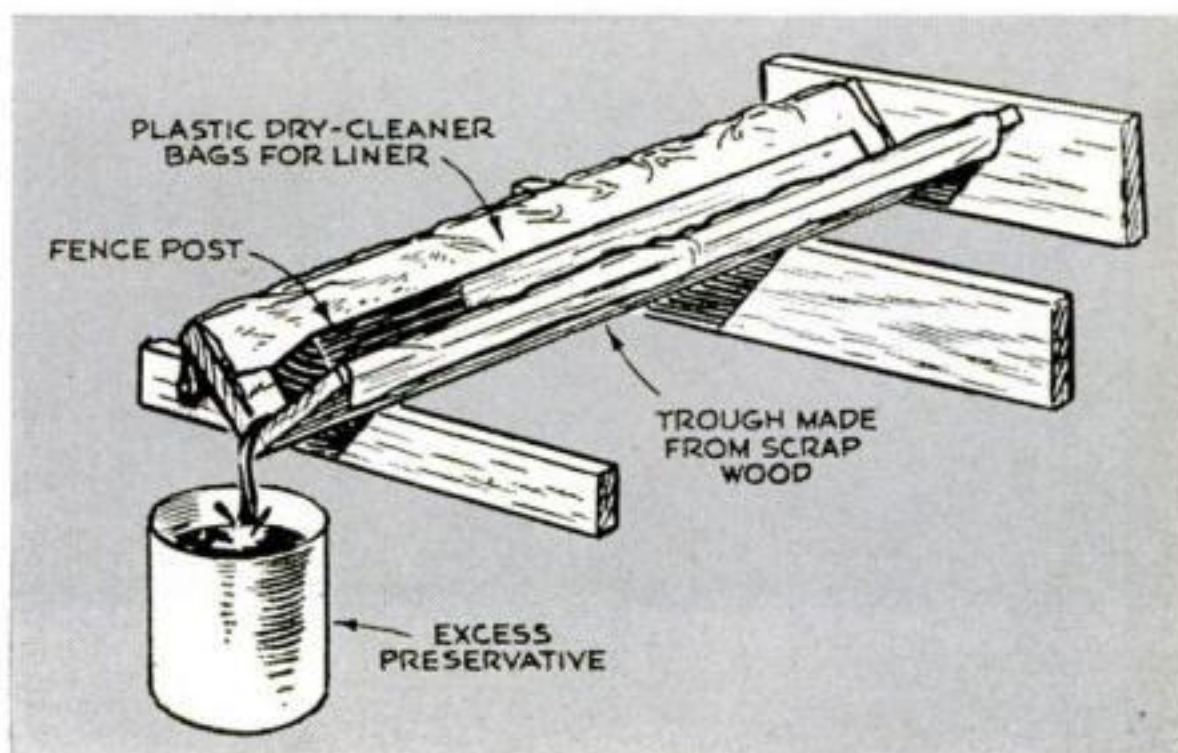
The unit that goes under the dash is a standard surface bolt of the type used at top and bottom of French doors. Take a sample curtain rod with you to the hardware store to make sure you get a bolt that will slip inside it. You can always crimp the rod for a snug fit.—*Jack Kenison, Tacoma, Wash.*

When you don't need it, just detach brace section (photo at left) and store in the glove compartment. Then push bolt out of way under the dashboard.



## Drainage trough for fence-post treatment

Fencing my new lot meant treating 40 posts with preservative. Brushing it on was a slow, wasteful process, until I devised the system shown at right. I nailed two planks together to form a trough, and lined this with plastic dry-cleaning bags. With a can at the low end to catch the surplus, I was able to flow the fluid on generously.—*A. Weber, Edmonton, Alta.*

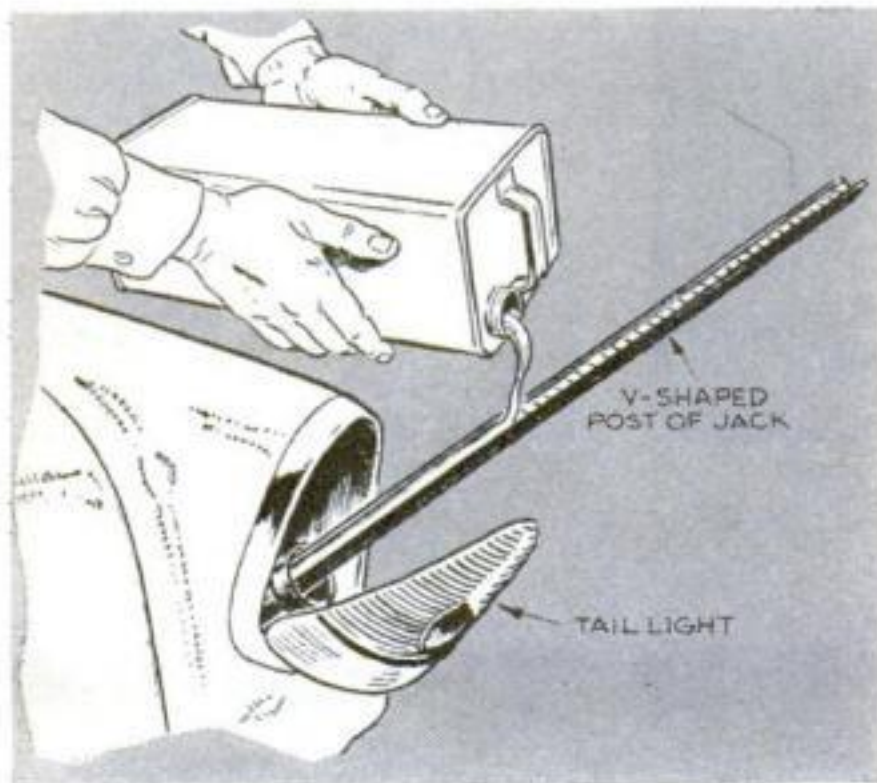
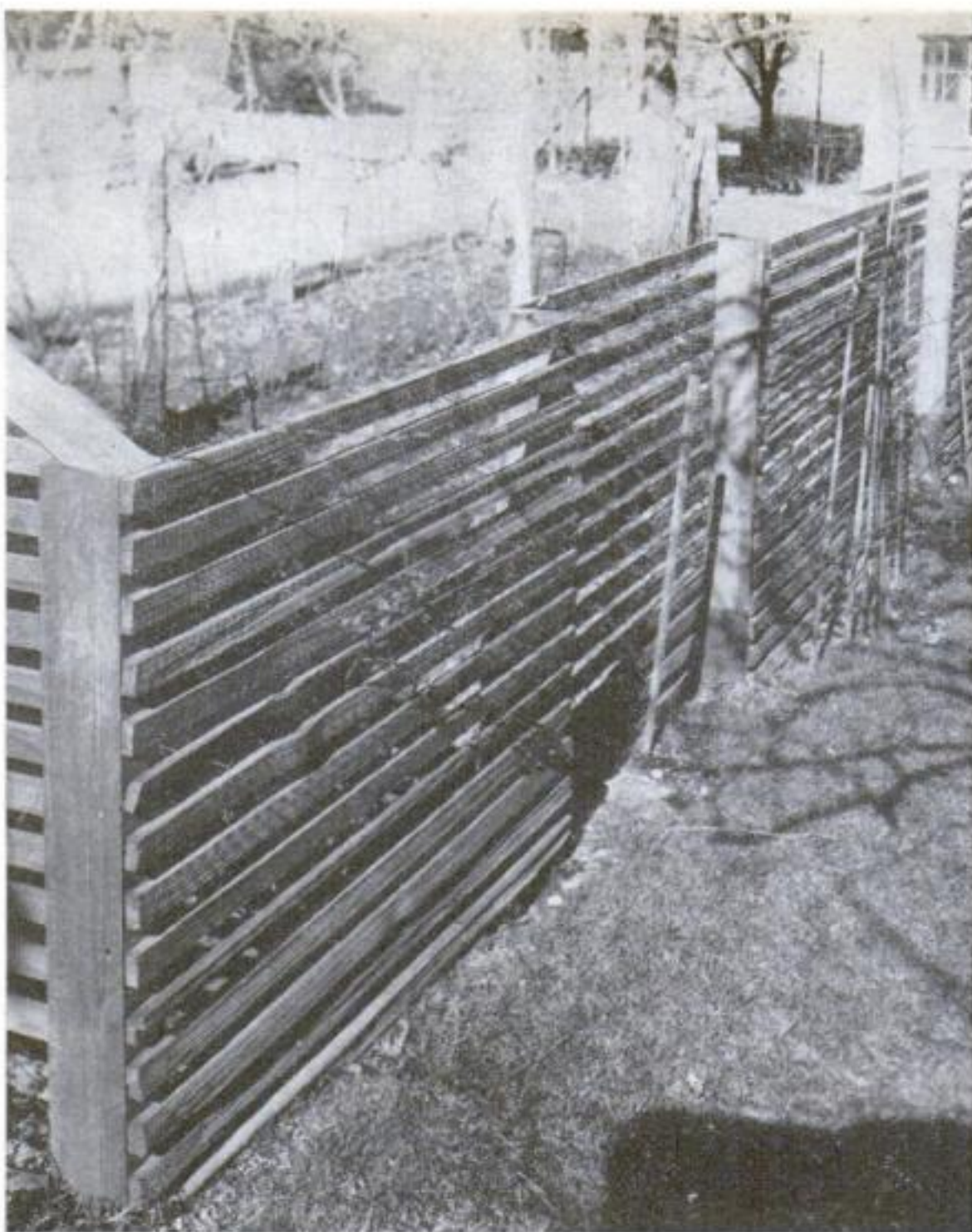




## Two-way cedar fence has no "wrong" side

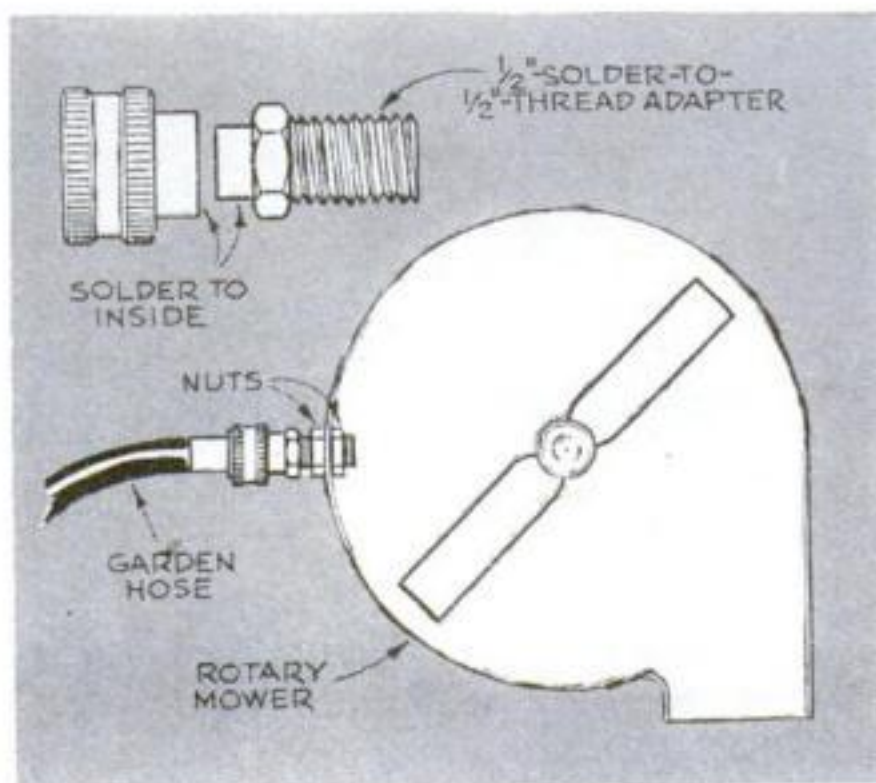
When you put up a fence, you worry: "Who's to get the ugly side, me or my neighbor?" This cedar fence (right) spares you that decision. It looks good from both sides. Rough-split stakes were nailed horizontally to alternate edges of three-by-six posts. The niches are ideal for planting.—*Don No-mark, Seattle, Wash.*

▶▶▶Preparing to paint my living room, I found many small nailholes in the plaster. With my wife's cake icer full of patching plaster (she was out at the time), it took only a squirt and a pass with a damp cloth to fill each one.—*A. Weber, Edmonton, Alta.*



## Pouring gas in a hard-to-reach tank

When my '56 Chevy ran out of gas and I had to pour an emergency supply from a five-quart oil can, I cursed out the designer who'd tucked the neck of the tank behind the tail light. Then I discovered that if I inserted one end of the V post from my auto jack, I'd have a trough to pour into.—*W. H. Perry, Birmingham.*



## Flush grass clippings from rotary mower

You'll never have to dig caked grass clippings from your rotary mower if you add fittings that let you couple your garden hose to the blade housing. After mowing, connect the hose, start the motor, and turn on the water. Whirled by the blades, the water flushes away all clippings inside the housing.—*A. W. Stinton, Brush, Colo.*



# What's the Stuff Good Boats Are Made Of?

**Aluminum? Fiber-glass? Plywood? Planking? Steel? See which best suits your purse and purpose**

**By George Daniels**

**I**T'S hard to sort out fact from fiction when you start trying to get information about the best material for a boat. Just scout around any large marina and you'll find at least five different hull materials in common use.

You'll see brightly colored trailer boats that have never been painted and never will be, cruisers so tough they're actually bulletproof, sturdy utility jobs light enough for two men to carry to the water, and some that are remarkable only for their small price tags. It's all in the materials.

But in spite of tales you may hear, there is no *one* best material. The one that will make the best boat for you depends on what you want to do with the boat and what you want the boat to do for you.

If you're looking for a strong but featherweight skiff to ride on your luggage carrier, the chances are it'll be aluminum. If you're based in risky waters and need a boat that can bounce off rocks unscathed, you'll probably pick fiber-glass and pay a little more—or, in cruiser-size, it might be steel. And if you want the biggest boat for your money it's likely to be plywood.

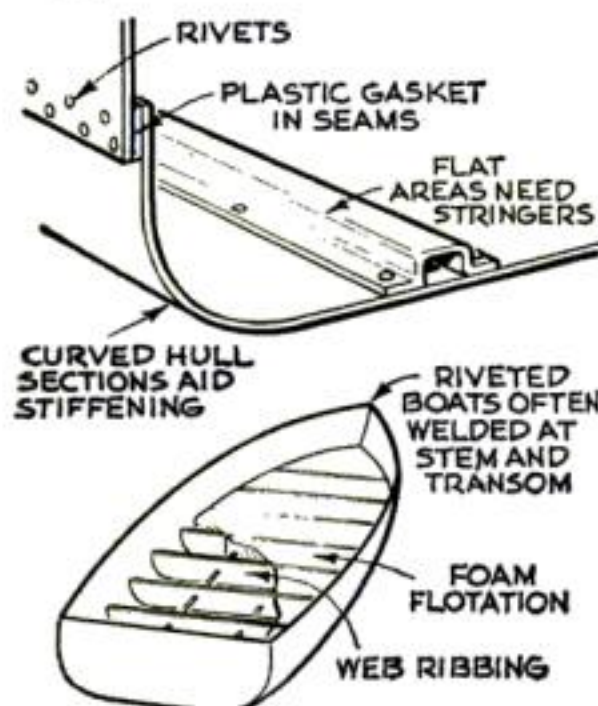
And don't fall for any fable that wood is being edged out by the newer materials. Far from it. Last year's marine plywood sales climbed better than 10 percent. Penn Yan Boats, Inc., one of the industry's leaders, producing hulls of fiber-glass as well

## How the Materials Compare in Maintenance and Noise Level

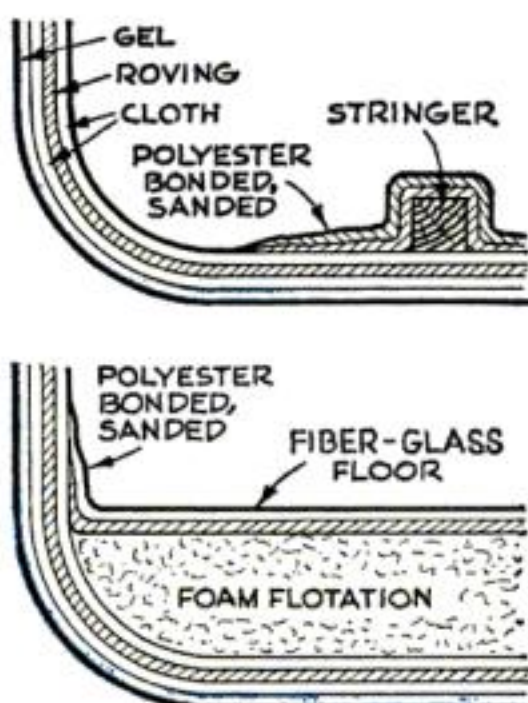
Material	Maintenance (Hull Only) Marine growth removal and replacement of antifouling paint is required on any boat moored in salt water and in some fresh-water areas	Limit of Owner Repair	Relative Noise Level Without Sound Damping Both hull design and material affect noise level. In general, large unframed areas increase noise level by acting as sounding boards. Important factor: motor-mount cushioning
<b>ALUMINUM</b>	Postseason washing. Check for loose rivets. Preseason painting unless hull is bare metal	Rivet replacement or hammer-snugging where loose. Repair of dents and small punctures (by riveted patch). No amateur welding	High-medium
<b>FIBER-GLASS</b>	Postseason washing. Preseason painting if resin color is faded. Sand and refinish any crazed areas	Patching of punctured or cracked areas not involving major hull section	Medium
<b>PLY-WOOD</b>	Preseason painting. Caulking chine and keel seams as needed on older hulls. Check fastenings; redrive where necessary	Any size repair within owner's wood-working ability	Low-medium
<b>WOOD PLANK</b>	Preseason painting. Caulking as needed on older hulls. Check fastenings; redrive where necessary	Major or minor repair on simple hulls; minor repairs such as butt-block patching on carvel or lapstrake if not involving large hull area or framing	Low
<b>WELDED STEEL</b>	Preseason painting. Check bolts and tighten as needed. On plastic-coated hulls, use repair kit to patch scraped areas	Minor damage not requiring welding	Medium



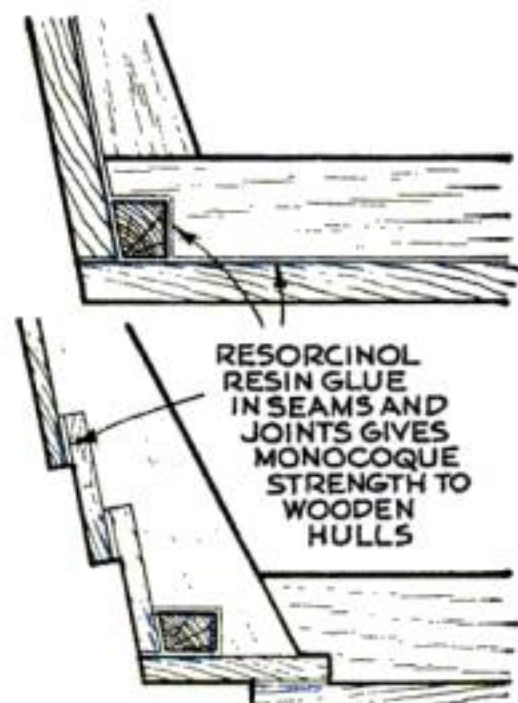
## Typical construction techniques with different materials



**Aluminum hulls** have panels fastened with rivets  $\frac{1}{2}$ " apart, or closer, with plastic gaskets in seams. Ribs and foam flotation may be used to stiffen bottom, deaden vibration.



**Fiber-glass hulls** are built up in layers of resin-saturated glass cloth and roving. Outer gel coat contains color. Foam flotation between floor and bottom provides buoyancy.



**Wooden hulls** are depending more on resorcinol glue. Boats with glued seams and joints are drier, lighter for same strength and size. Even frameless hulls have been glued up.

as wood, provides the explanation: Their fastest-selling line is a wood-framed plywood lapstrake design. Why the popularity? The materials are boatbuilding's most thoroughly proven ones, and customers know it. So does Penn Yan. Of its first

six boats, cedar-planked fishing skiffs built 40 years ago, five are still in operation.

**Better than ever.** Whatever the material, a new boat is pretty sure to need less babying than in the past. The aluminum jobs form their own protective coating simply from contact with the water. Fiber-glass with a built-in antifouling finish may not be far off. And, if you like the quiet comfort of wood, you can now buy a traditionally planked wood boat with seams that can never leak and never need calking. Cruiser and yacht builders seal the seams permanently with Thiokol and similar products.

Check carefully on any scare stories you hear that might steer you away from a boat you want. The facts are often garbled, and blanket condemnations of a particular material frequently get started from a single freak experience.

**Aluminum**, to start alphabetically, is a good example. Its marine alloys do *not* corrode in salt water. But many a Sunday sailor insists they do. Actually, the water forms a gray oxide film about .002 or .003 inches thick. This seals the metal with a natural protective coating and makes paint unnecessary except for style or antifouling effect.

The corrosion idea stems largely from postwar quick-buck hulls made from sur-

## What do they cost?

Because of variations in detail a clear-cut price comparison between boats of different materials can't be made, but the following sample prices on these 14' to 14½' runabouts give a fair idea:

Aluminum 14'	\$695
Fiber-glass 14'	\$795
Molded ply 14½'	\$688
Ply lapstrake 15'	\$649
Plywood 14'	\$500

Steel is hard to find in this size. Planked jobs are scarce, somewhat larger, and mostly inboard or inboard-outboard, sold as a unit. In larger sizes, aluminum goes into a different price bracket as construction shifts to heavier welded hulls.



## Do-it-yourself patches



**Plywood:** Cut away damaged part and make a snug-fitting plug to fit in hole. Glue and screw an overlapping butt block to cover hole. Coat plug generously with resorcinol glue and press into hole.



**Fiber-glass:** Cut away damage, leaving a beveled rim around hole. Tape cellophane-wrapped cardboard over hole to back up patch. Lay up epoxy-saturated fiber-glass until patch is flush with surface.



**Aluminum:** Rivet patch in place, using a neoprene gasket. Be sure patch and rivets are the same alloy as the rest of the hull. A temporary patch can be made with a latex adhesive such as Pliobond.

plus aluminum-copper alloys that went to pieces fast in salt water. But any aluminum is electrolytically touchy. Other metals below the waterline must be insulated from it with a nonabsorbent, such as neoprene. And where an antifouling coat is

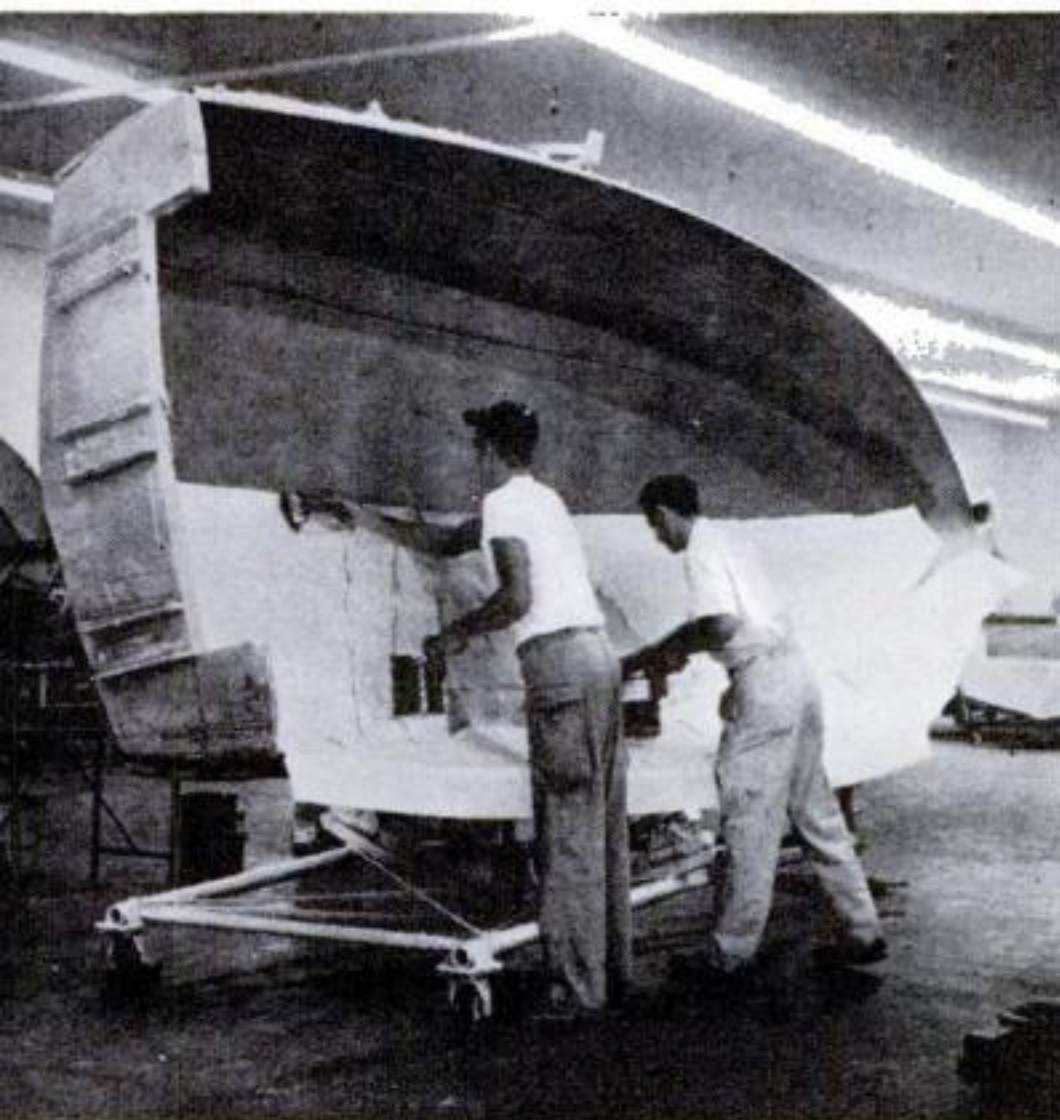
necessary, it needs a special paint system—never one with a mercury base. The safest bet: Get instructions from the boat manufacturer.

Pound for pound, aluminum is about as strong as fiber-glass. Its yield point is about the same as mild steel, around 50,000 pounds per square inch, and it weighs a little over a third as much. So it can be used about 40 percent thicker for rigidity, and still make a boat a third lighter. This gives you a 12' car-topper as light as 80 pounds—like Duratech's CT-12—at around \$160. About 90 percent of the small jobs are riveted, as distortion problems of thin-gauge welding increase cost. But thicker-skinned cruisers and ocean racers, with their  $\frac{1}{4}$ " plate, are welded. Stiff hull design, acoustical coating, or foamed-in flotation lick the annoying noise problem from motor vibration that plagues smaller boats.

Although aluminum is not an ideal do-it-yourself material, you can easily bang out a dent with a rubber mallet, even if a seam runs through it. The repaired seam won't leak, thanks to a gasket of neoprene or Alumelastic sandwiched in it, and rivets staggered at  $\frac{1}{2}$ " intervals. How reliable is an aluminum hull? At least one manufacturer (Starcraft) gives a 15-year guarantee against puncture or rivet-popping.

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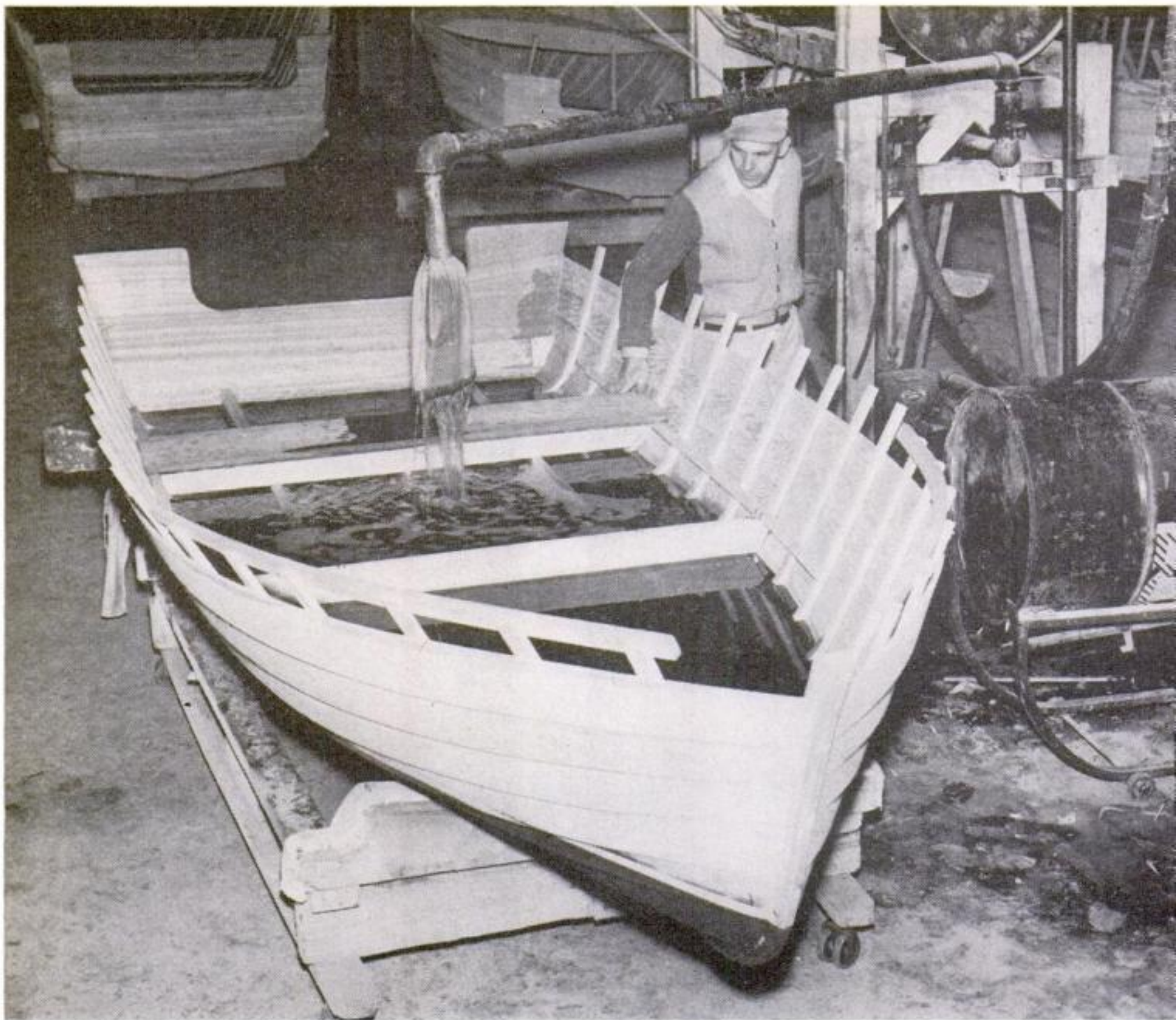
## Hull molding encourages mass production of small boats



**Transparent dinghy** above, made by Sudbury Labs is vacuum-molded from Tenite butyrate. Total weight is 44 pounds. It can take a three-hp. outboard, carry a total load of 600 pounds.

**Fiber-glass hull** is actually built inside the gel-coat finish in this female mold. Each layer of cloth is added while resin in previous layer is still tacky to make homogeneous bond.





**Powerful fungicide** pumped into this Penn Yan lapstrake plywood hull will prevent future rot. It is also a stringent test of the watertightness

of the new hull's permanently sealed seams—the penetrating fungicide will leak through seams where ordinary water will not.

**Fiber-glass** is the designer's dream. It's moldable to almost any conceivable shape, yet so tough it's actually bulletproof (tested with a police .38) in cruisers like the Hatteras line. For worriers about its lasting qualities, the earliest fiber-glass hulls, built in 1944, are still going strong. Only a sustained flame can set it afire (the resin burns, not the glass) and it burns about like plywood. New, flameproof resins are being tried. As the color is built into the outer resin (gel) coat, it doesn't need paint, and Naugatuck Chemical is working on built-in antifouling for complete launch-it-and-forget-it performance.

The strength comes from fabric woven in glass strands, two to four thousandths of an

inch in diameter, with a tensile strength of 400,000 pounds per square inch—about five times that of carbon steel. A melted marble yields about 90 miles of the stuff. Around six *million* miles go into a 40' cruiser. In the resin it acts like iron mesh in reinforced concrete. The glass-polyester combination is one of boatbuilding's toughest skins, but it's not cheap. Enough of both for an 8' pram retails for around \$50 to \$70.

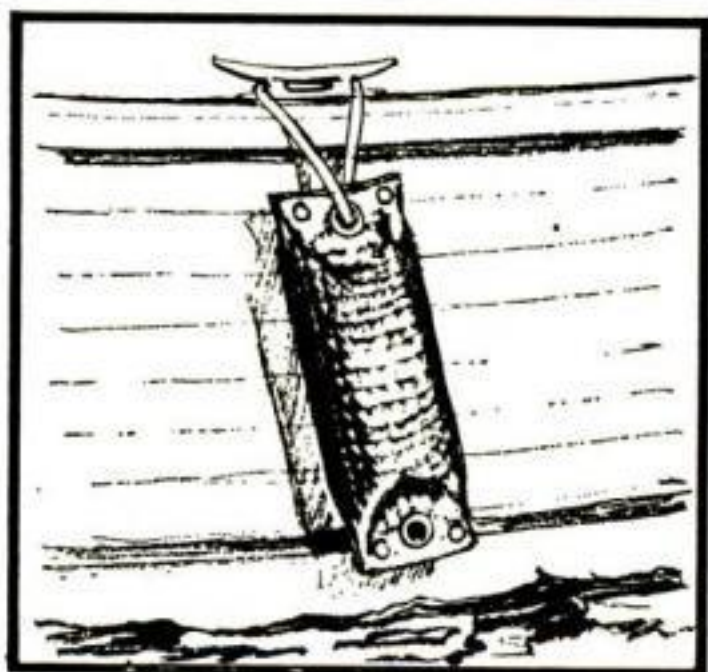
Another costly item in a production hull is the mold it's built in. This also keeps fiber-glass out of most custom-built jobs. But fly-by-nights often build their own mold directly over a new boat and go into

[\[Continued on page 218\]](#)

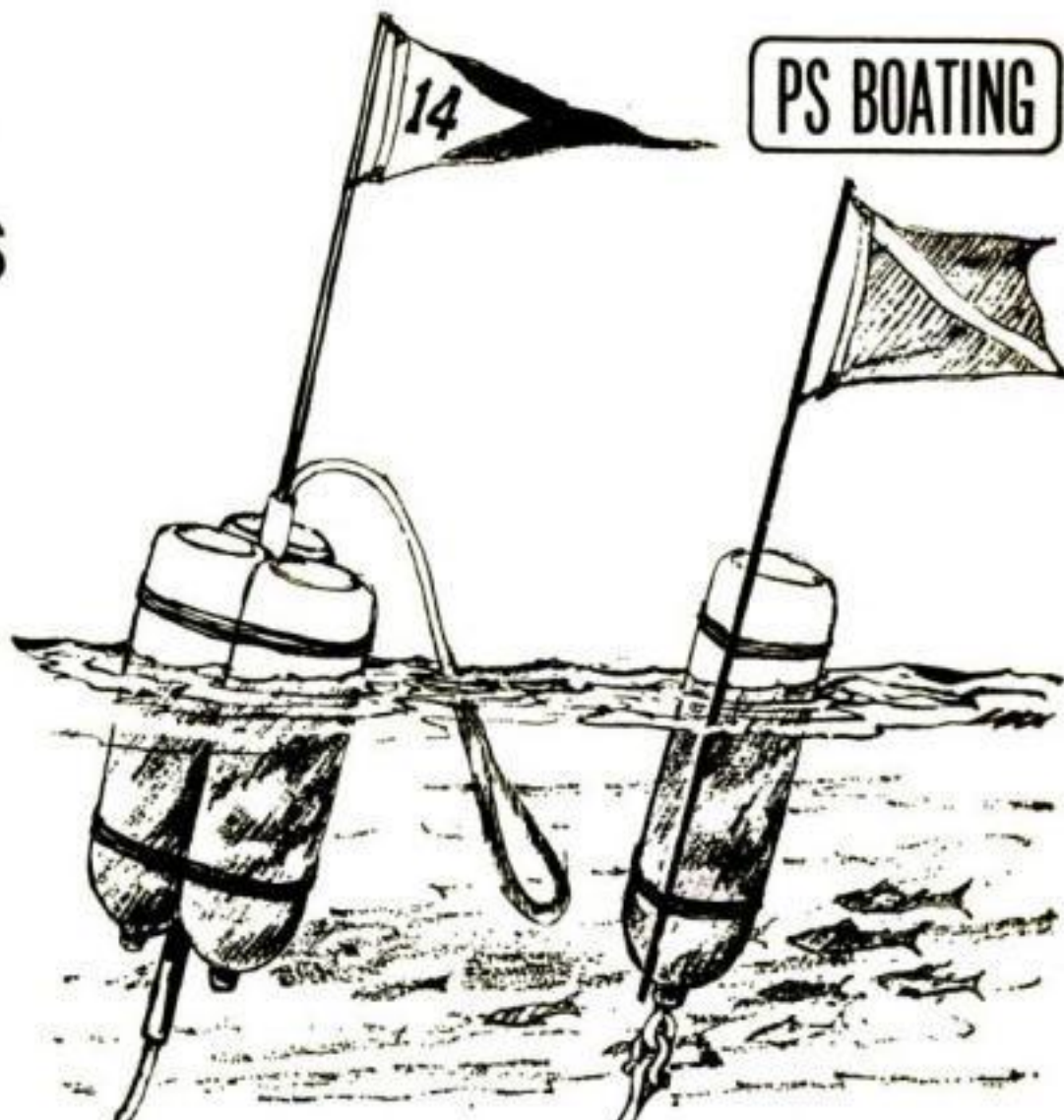


# 3 Homemade Accessories for a Boat

PS BOATING



Inexpensive fenders can be made from worn-out canvas fire hose, often available at local fire departments. Cut the hose into 16" lengths, stuff with rolls of old inner tube, and seal ends with rivets. A grommet at one end lets you tie the bumpers to deck cleats.—*R. M. Woodbury, Natick, Mass.*



Discarded propane tanks of the type used in small soldering torches make fine buoys for marking moorings, skindivers, or fishing grounds. One tank will support a small flagstaff. For greater buoyancy, strap three tanks together around a length of electrical conduit, which forms a channel for the line and a flagpole holder. Tapering the end of the pole will wedge the line tight in the conduit at the proper length.—*A. Fiess, Syracuse, N. Y.*

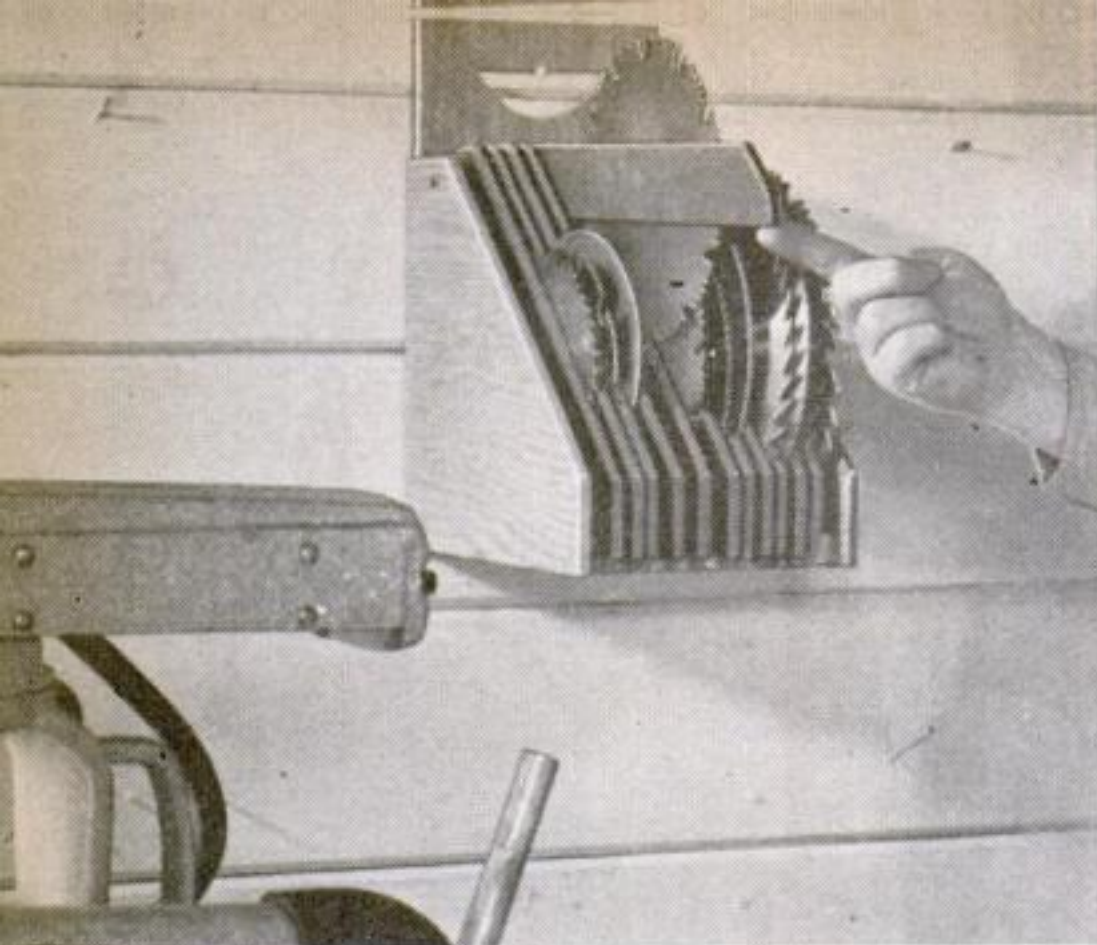


The homemade boat davits above let a small pram or dinghy hitchhike behind a larger outboard or cruiser. They hold the boat out of the way where it doubles as a rain shield for the outboard motors. Two 4' lengths of chrome exhaust tube, picked up for \$2 apiece at a junk yard, form the up-rights. Two T-shaped pieces of 1½" hard-



wood slip into the tops of the tubes to support the boat and are wrapped with nylon line for padding. The tees should be cut at an angle so their tops come out level. I bolted the tubes to my engine-mount extension, but they could also be fastened directly to the transom.—*Victor W. Kondra, Temple City, Calif.*





## How to make a Selector Rack for Circular Saw Blades

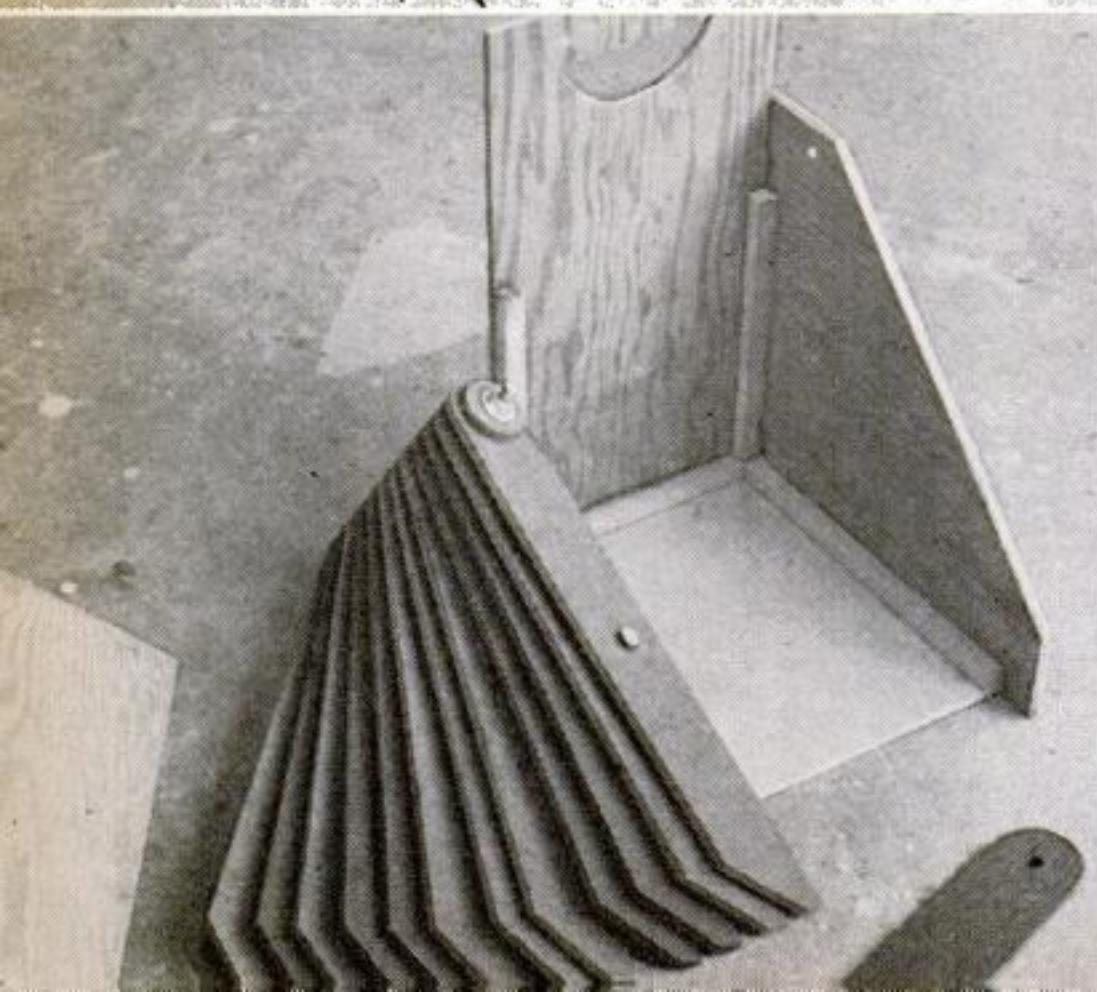
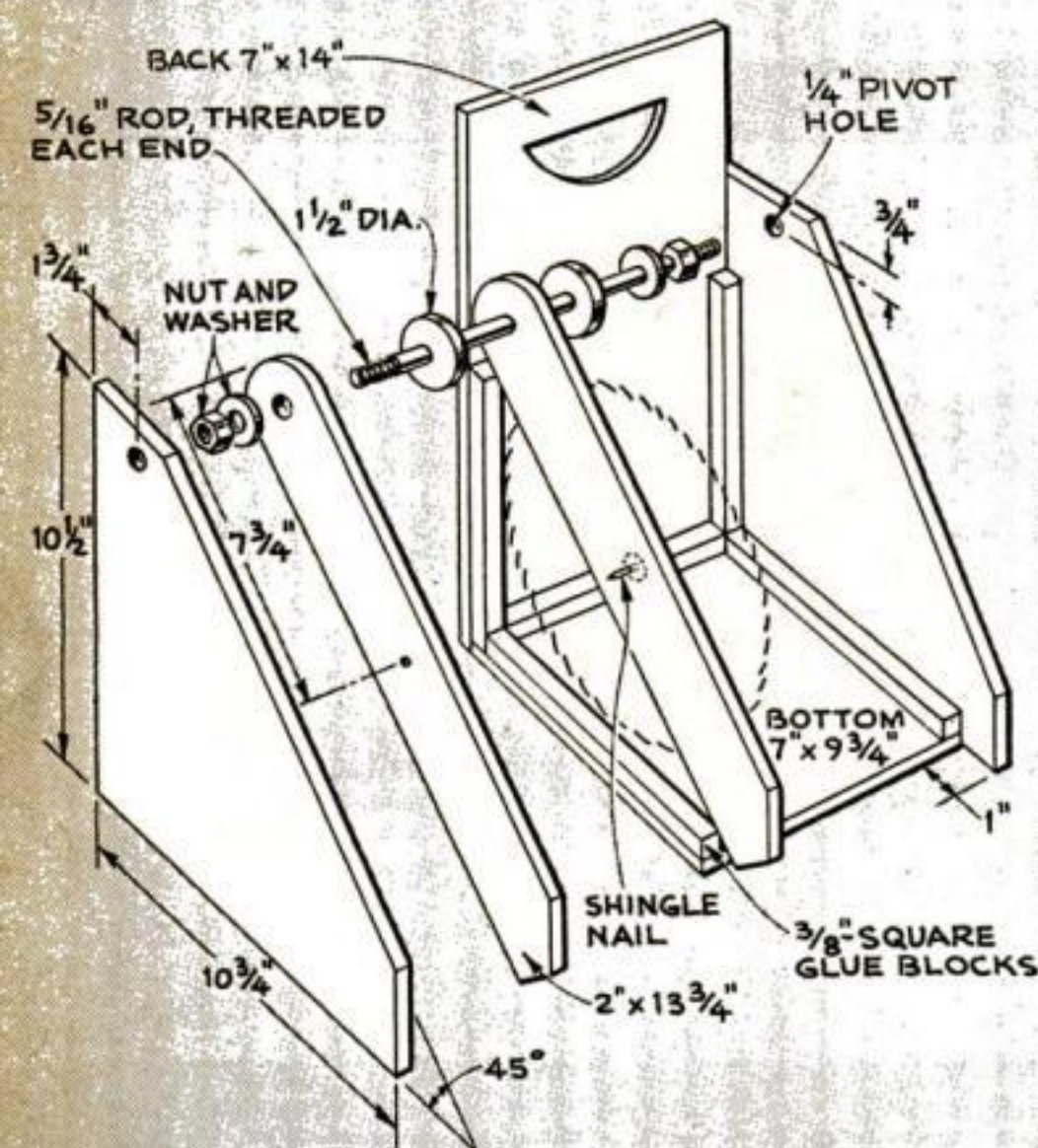
**R**AISE a finger of this easy-to-make holder, and the circular saw blade you choose lifts up for easy removal. When you're through with the blade, you just rehook the center hole onto a nail in the finger, and pivot it back into the rack for safe, compact storage.

The usual method of storing blades—hanging them flat against a wall—takes a lot of space, and prying up the sharp edges to get a grip is both awkward and dangerous. If you place more than one blade on a nail, the cutting edges dull each other.

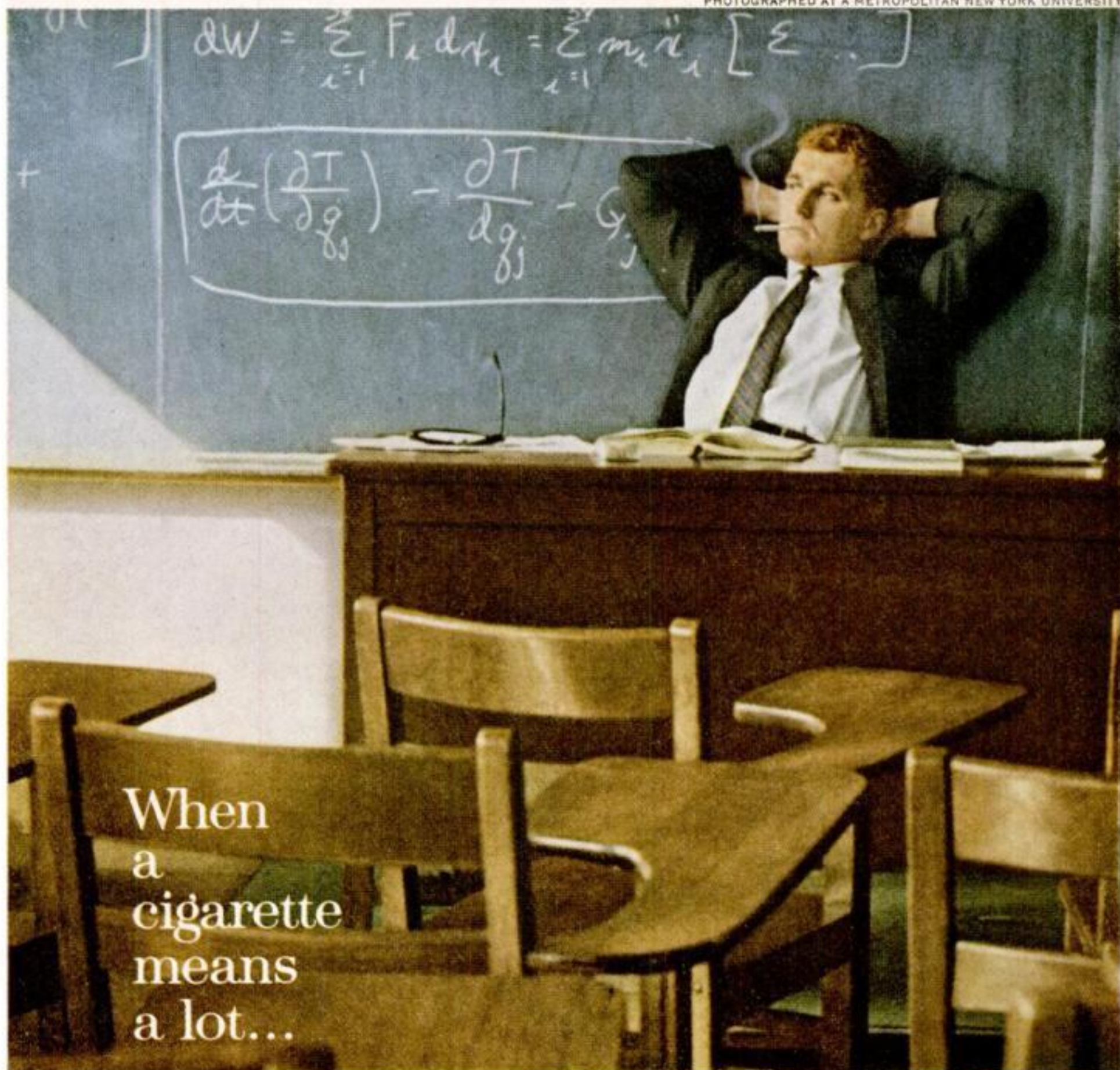
With this rack (which can be hung on a wall or set on a shelf) you never touch the saw teeth, and the blades don't rub against each other. When they get dull from use, you just carry the loaded holder to the sharpener's shop, avoiding the bother of wrapping each blade.

You can tailor the dimensions to your own saw collection. Fit it to the largest blade or cutting wheel. It will then handle anything up to that size. The rack shown holds a dozen blades of diameters up to 10", yet takes only 7½" of wall space. The case was built of plywood, the fingers and spacers of hardboard—all ¼". The nails were driven through the fingers so the heads stuck out ¼"; the points were then ground off flush with the opposite face.

Only one side of the case is fastened in place at first. After fingers and spacers are alternately fed onto the rod and a nut is tightened at each end, the assembly is lifted into the case. The protruding rod is inserted in the pivot hole. Then the second side is attached, securing the other end of the rod.—W. G. Waggoner.





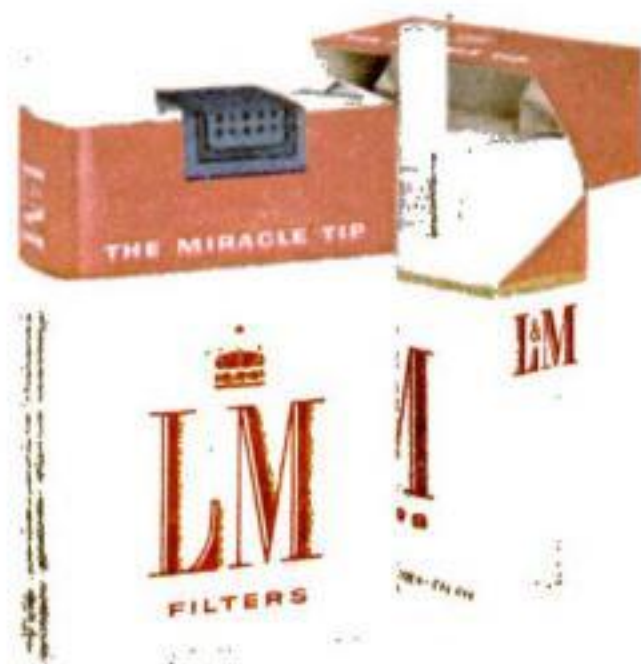


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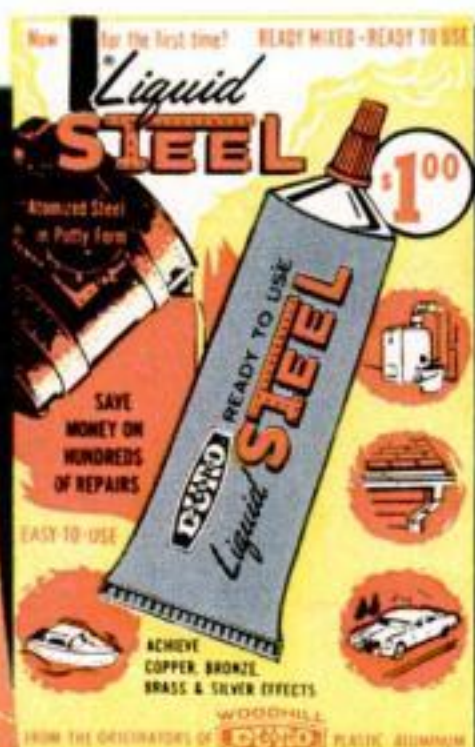
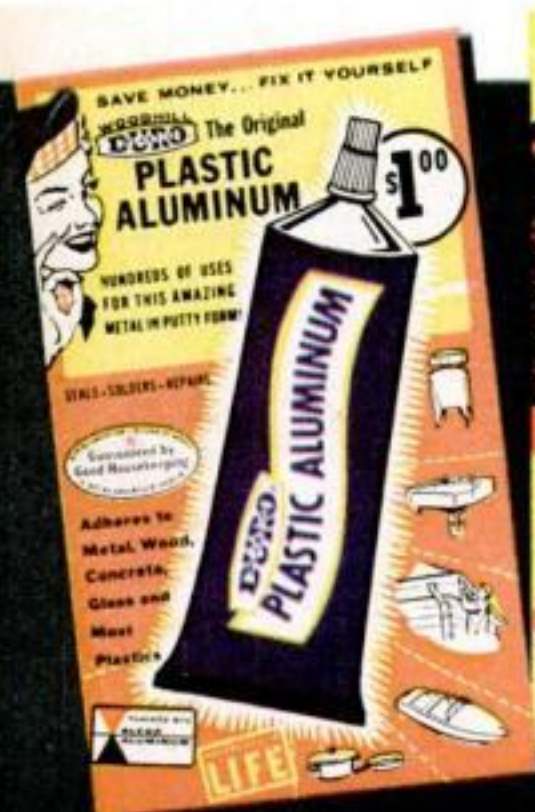


... to dining chair



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\* well, just about everything



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# Ways to Add a Room



**ONE COMMON EXAMPLE:** How a typical five-room Cape Cod house might grow as your family grows



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G. K. Geerlings      Herbert Richheimer

## Two Experts Show You How

**N**EEED more living space? Gerald K. Geerlings and Herbert Richheimer are two of America's foremost home-improvement experts. Their answers to the problems of adding space, based on years of experience, appear on the following pages.

A nationally known architect, Jerry Geerlings is also the author of several books and countless magazine articles. His advice on home planning has been read by millions over the past 30 years. He has also served as a consultant to builders and as a member of various architectural panels. More recently, he designed a full line of shell houses for the Institute of Essential Housing. More than 10,000 of these have been sold in the past year.

Herbert Richheimer learned the home-improvement business the hard way. Eight years ago he was a salesman living in Long Island's massive development of low-cost homes called Levittown. "Tomorrow's slums," everybody said.

Richheimer refused to believe it. He found that most of his neighbors were willing to make improvements, but weren't quite sure how. He worked out special schemes for turning little houses

CONTINUED

# Home Improvement Ideas

FALL 1962

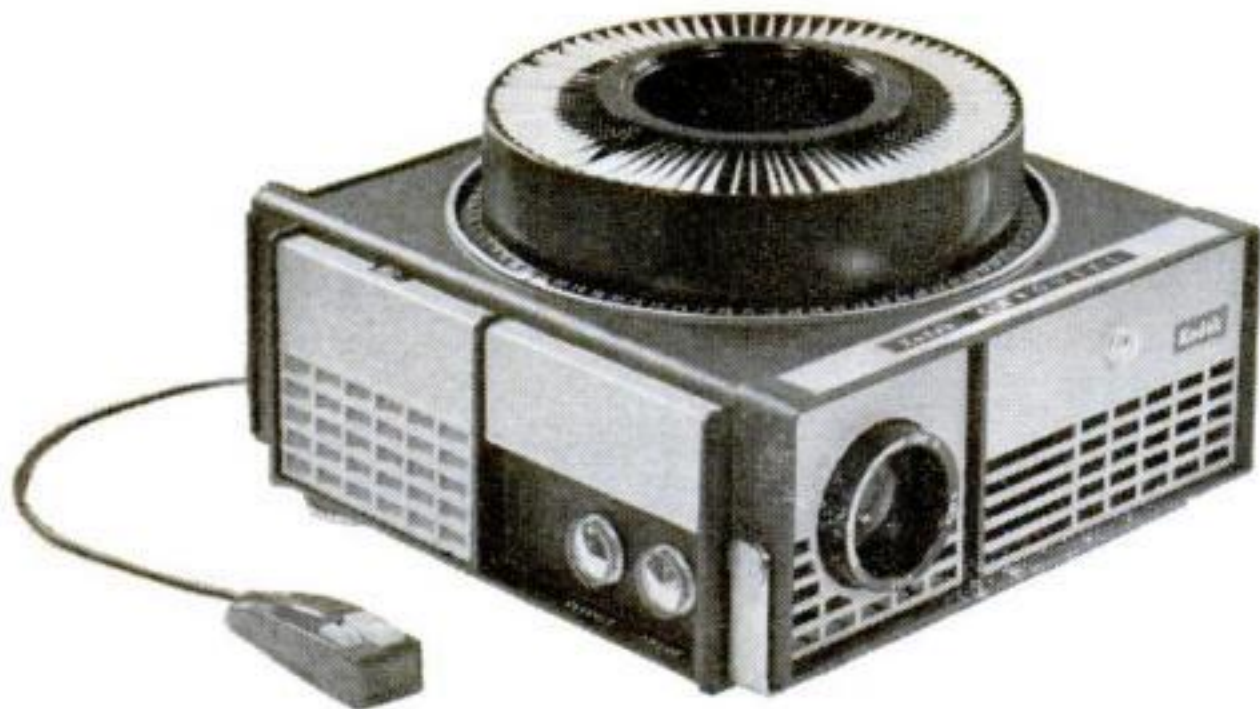
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• • •

*"Home Improvement Ideas," published as a supplement to a regular issue of "Popular Science," is devoted exclusively to the physical betterment of the average man's greatest investment—his home.*

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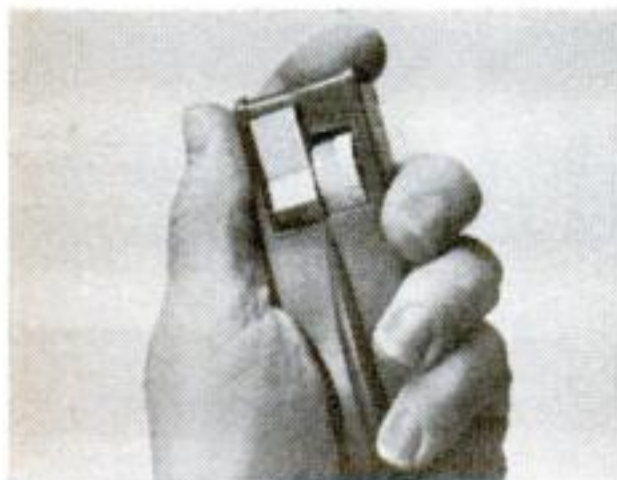
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# *"It always pays to improve"*

—says Herbert Richheimer

into big ones, pooled the family savings, and went into business as a remodeling contractor.

To help customers visualize exactly what they were getting, Richheimer began demonstrating his principles with scale-model cardboard houses. The models, some of which are shown on the following pages, became a hit overnight. Since then, Herbert Richheimer, Inc., in Hicksville, N.Y., has completed nearly 5,000 remodeling jobs, and the original dream-on-a-shoestring has mushroomed into a million-dollar-a-year business. Richheimer now spends much of his time as a consultant to the whole remodeling industry.

Richheimer's philosophy is based on a simple fact: "It's cheaper to expand a small house than to move to a bigger one." Why? Rising costs make a new home more expensive even if it's the same size; a larger home is even more expensive. "On top of this," says Richheimer, "you have the expense of moving, the expense of negotiating a new mortgage, the expense of new furnishings, landscaping, and so forth."

Altogether, Richheimer figures it costs up to several thousand dollars more to buy a new home than to add the equivalent amount of new space to your old one. He has some bold and surprising answers to questions that have an important bearing on planning new living space:

**Q** *Is it risky to improve a small home? Can you put more into it than you may get out of it later?*

**A** Nonsense. Unless a house is a real wreck or in a run-down neighborhood, it always pays to improve. Look what happens. You finish off your attic. Your next-door neighbor adds a porch. The guy across the street puts on a playroom. Pretty soon the whole neighborhood gets better, and your house with it, because real-estate values go up.

**Q** *How much should you spend on a house?*

**A** Well, you probably shouldn't put \$6,000 or \$7,000 in a \$12,000 house.

But I'd go up to \$5,000—that's safe enough. The original Levitt houses sold for \$7,000 to \$9,000. Now they're worth \$14,000 to \$15,000—and some you can't buy for \$20,000. What's risky about that?

**Q** *Does a small improvement pay off?*

**A** Any improvement pays off, provided you get something really useful for your money. Many Levittown owners paid about \$300 to have a small jog—originally the entranceway—taken out of the kitchen. It gave them 16 square feet more—enough for a breakfast table. Of course it paid off.

**Q** *Does it pay to rearrange an existing floor plan?*

**A** Not if it's extensive. It's okay to knock out a wall to make two rooms into one, but when you start pushing walls all over the place, results aren't worth it.

**Q** *Is it possible to convert a basement to actual living space?*

**A** Yes, and it's a good deal cheaper than adding the same space above ground. But the cellar must be dry, well ventilated, and have the approval of building codes.

**Q** *What are the most common mistakes in planning an expansion?*

**A** There are two. People often insist on something that doesn't look right for the house and it ends up badly. They also frequently overstate their needs. They want a big playroom, find they can't afford it, then become discouraged. Often a different way of doing the job will give them almost the same results at much less cost. The important thing is to consult a competent contractor or architect first.

**Q** *Who should make the plans—the contractor or an architect?*

**A** On small jobs, most contractors will include plans in the basic price. On large jobs, say \$8,000 or \$10,000, an architect is worthwhile.

*[Continued on page 184]*



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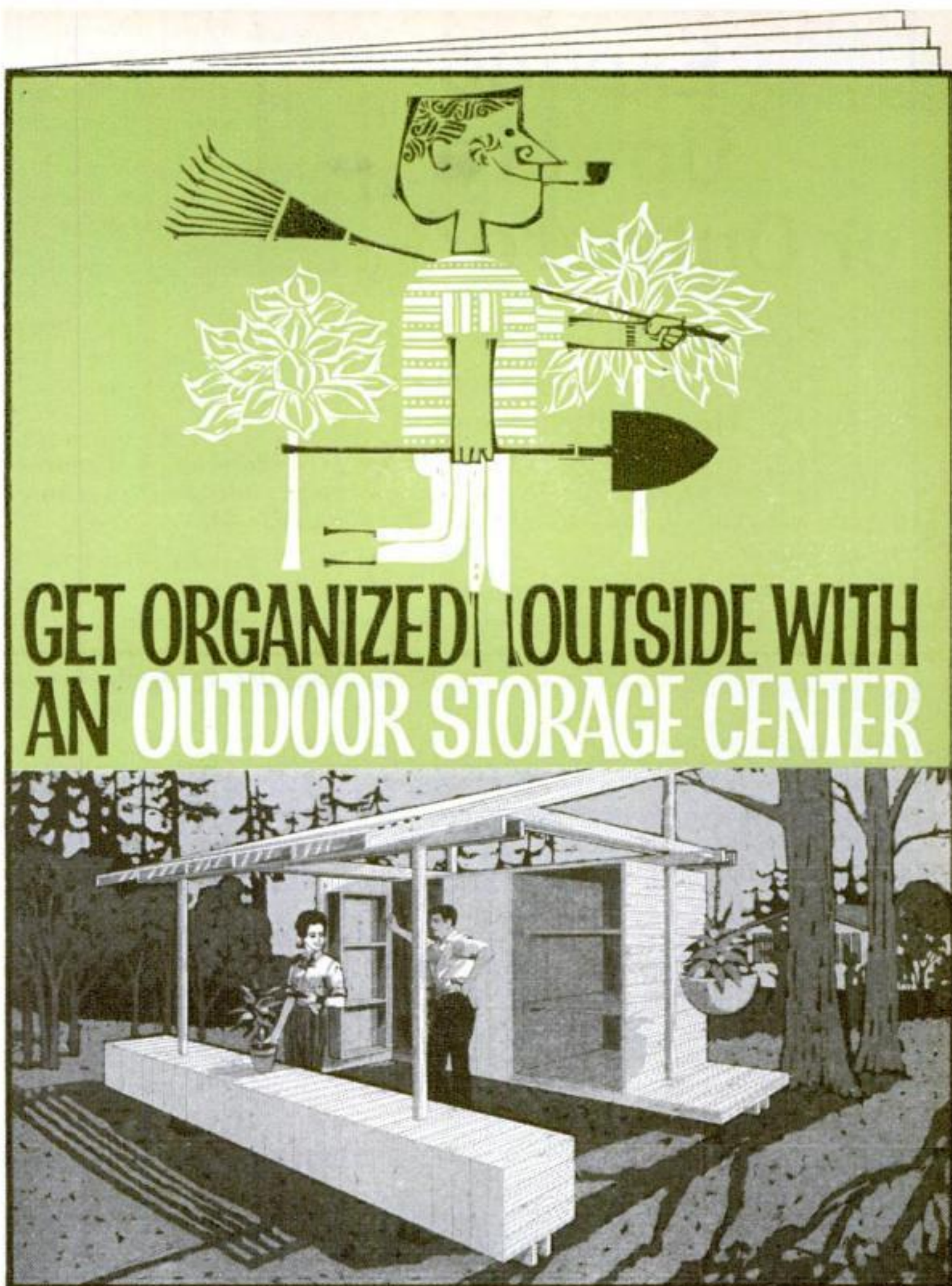
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# Expand Upward or Outward?

Which is best? Here are answers from Herbert Richheimer

**Q** *What's the cheapest way to add new living space?*

**A** In terms of square feet, you get the most space for the least money by finishing an attic. On the average 25'-by-32' house, I can add a 28' shed dormer, two finished bedrooms and a bath, heating, plumbing, and wiring for about \$3,200.

**Q** *Then it's always cheaper to go upward than outward?*

**A** No, no. It depends on how much space you need. Suppose you need only one room. I can put on an 8'-by-10' side extension for about \$1,400, a 12'-by-12' extension for about \$1,600. In this case, it's probably cheaper to add your room downstairs than to go upward and expand the attic.

**Q** *Can any attic be expanded?*

**A** No. Sometimes too much work must be done to make it economical. Have your house footings, attic-floor beams, and other structural members checked to see

if they're strong enough to support new rooms above them. Be sure there's space to run a stairway up to the attic. If too many structural changes are needed, you're better off expanding downstairs.

**Q** *Suppose the attic space is taken up by a truss roof?*

**A** A truss roof is no problem these days, but you do have to strengthen the joists and rafters so the struts can be cut away to give living space. Here again, it's worth it if you need that much space.

**Q** *Is a double shed dormer, one on each side of the roof, worth the extra cost?*

**A** Many people think this is a luxury, that it just gives you a few more windows and some more light and air. But look—you get up to four bedrooms plus a bath, compared with the two bedrooms and bath of a typical single dormer. For a big family, it's a bargain.

**Q** *Is it possible to add rooms in an attic without installing dormers?*

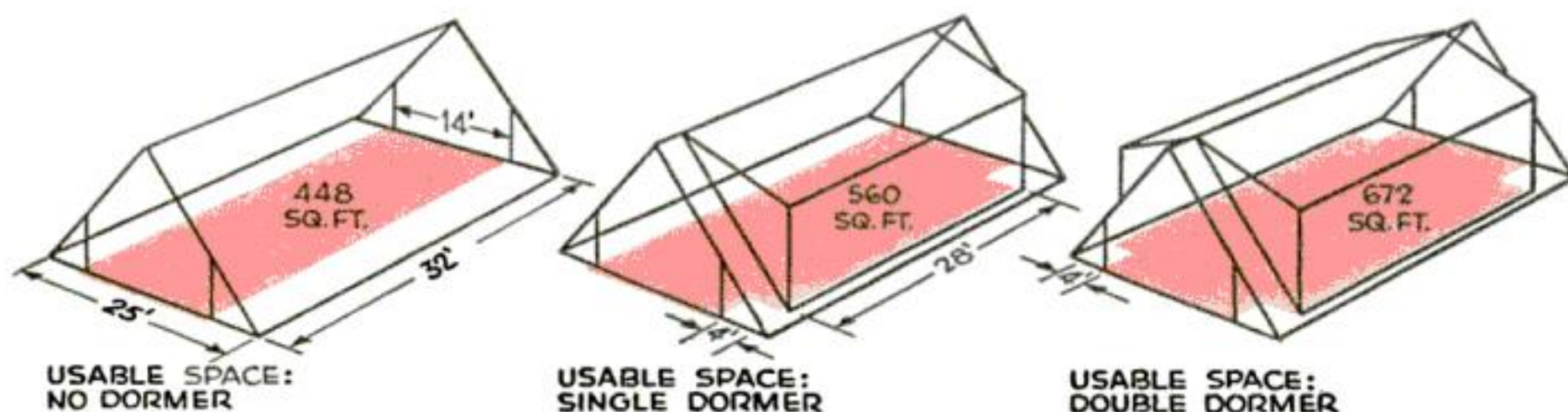
**A** In some cases. If you have a high-pitched roof—10' to 12' at the peak—you can add two rooms and give them each one window in the end gables. Or you can add a bath and one room. But if you want two rooms and a bath, too, then you have to put in at least a small dormer to give the bathroom ventilation.

**Q** *What determines attic-room size?*

**A** Most local building codes require that 50 percent of the enclosed area in a finished attic must have a certain minimum

[Continued on page 186]

## How adding a dormer increases attic space in a typical house





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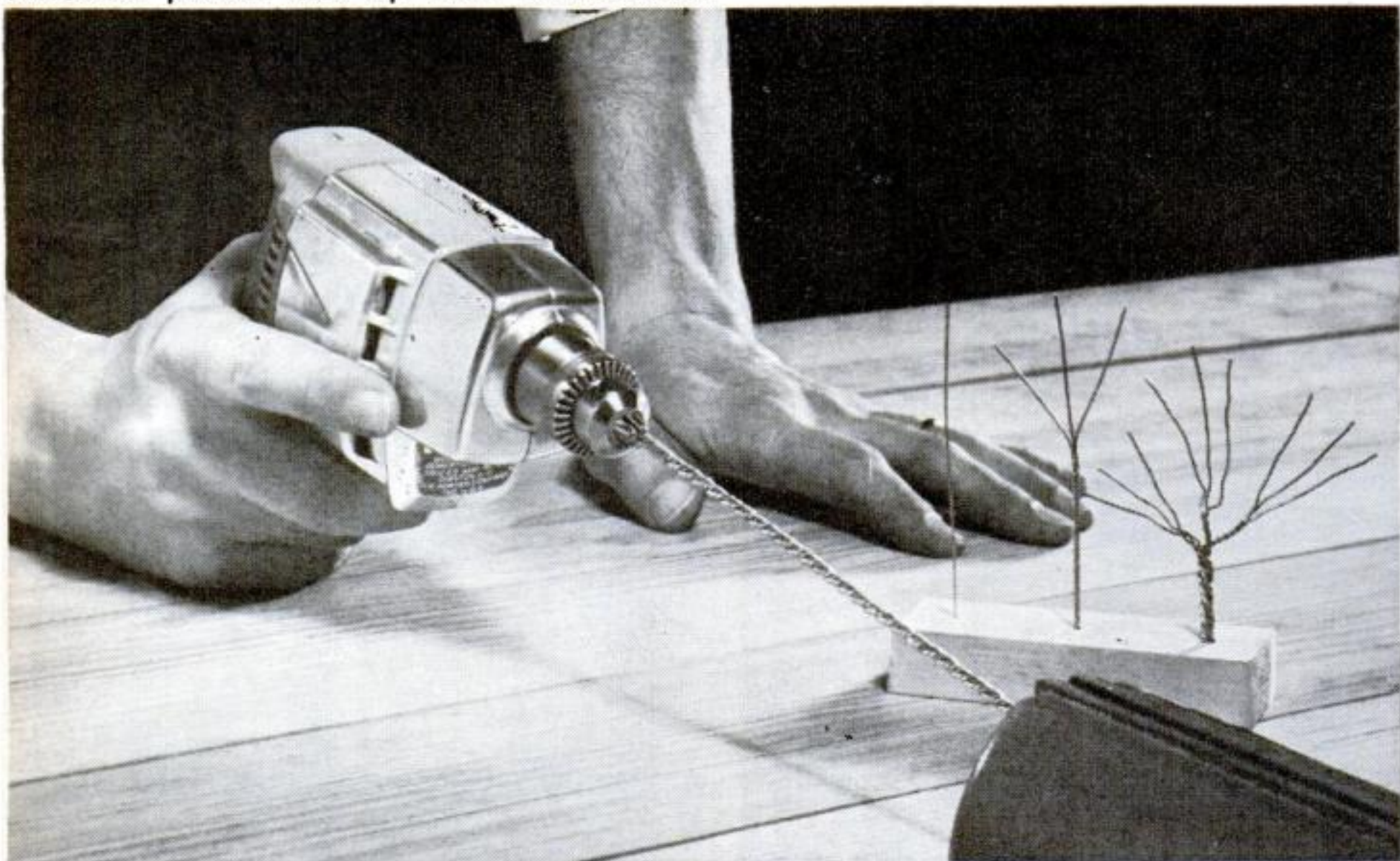
Don't be stymied by lack of materials when you find the time and have the inclination to tackle some household projects. Set up a basic Weldwood® Fix and Finishes shelf in your workshop with Weldwood Deep Finish Firzite. Weldwood Presto-Set, Contact Cement, Plastic Resin, Epoxy, and Resorcinol Glue will handle any gluing job. Get these and Putty Sticks®, Flexible Wood-Trim at almost any lumber yard, paint, or hardware store.



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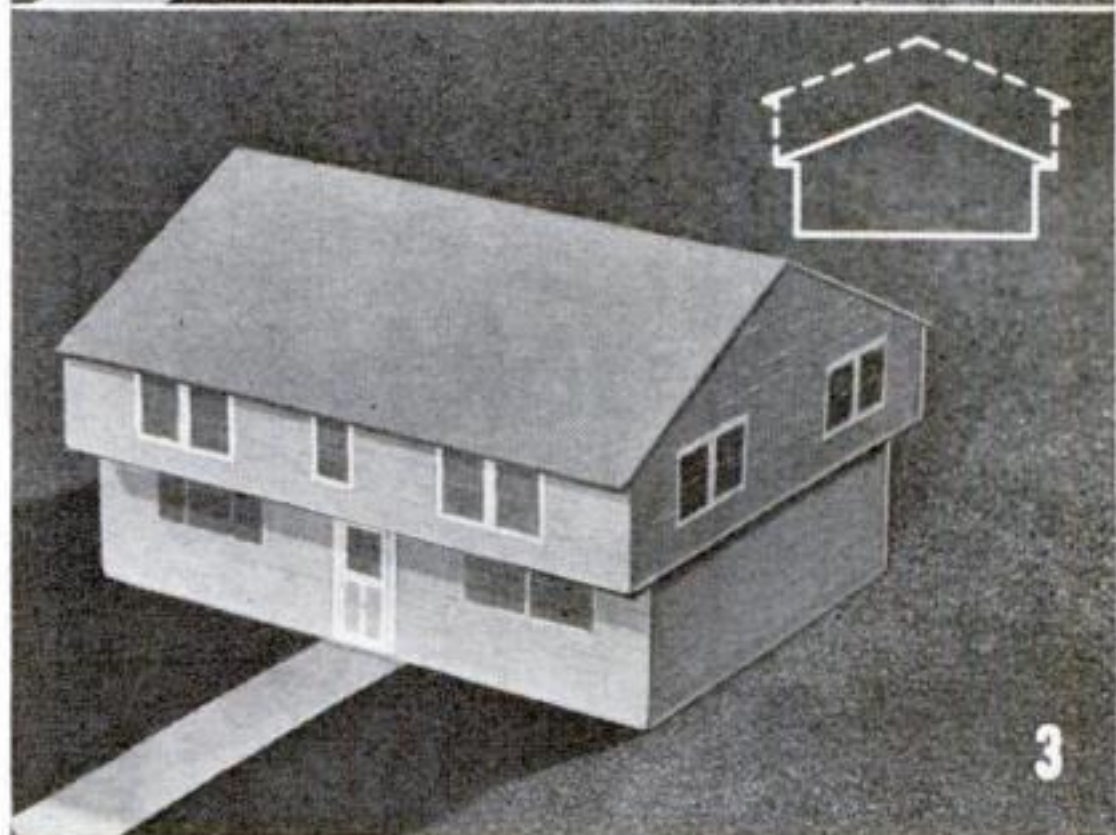
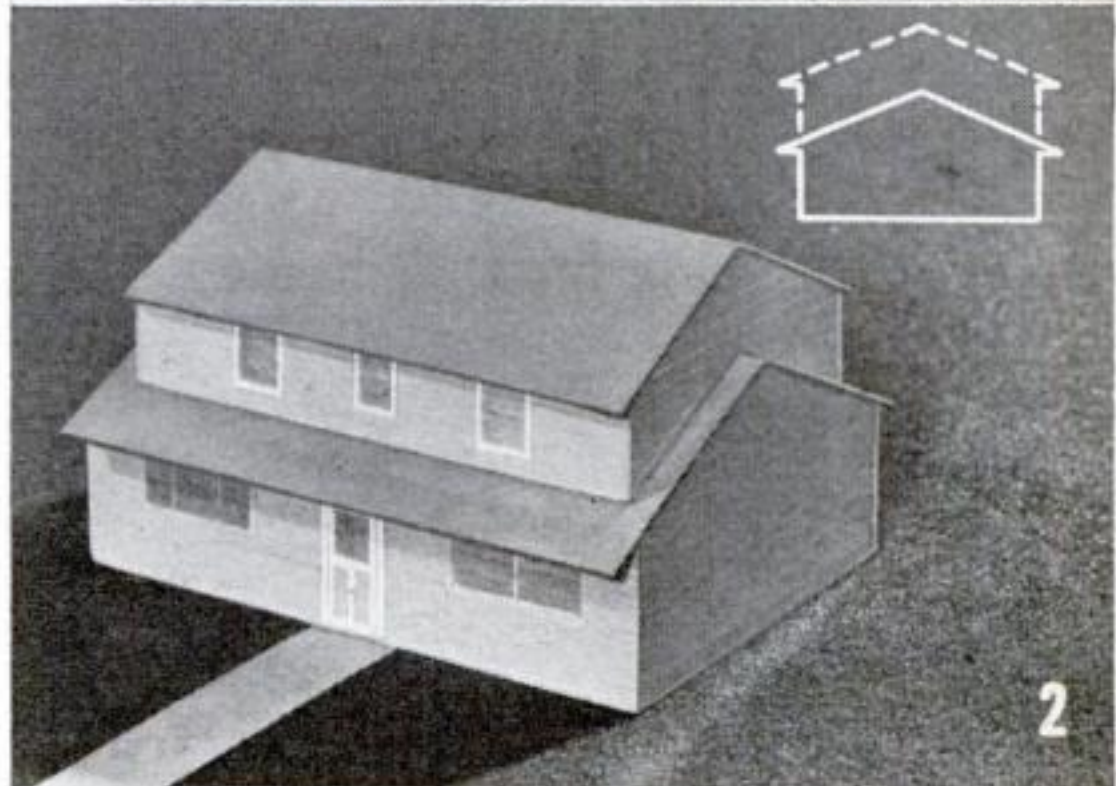
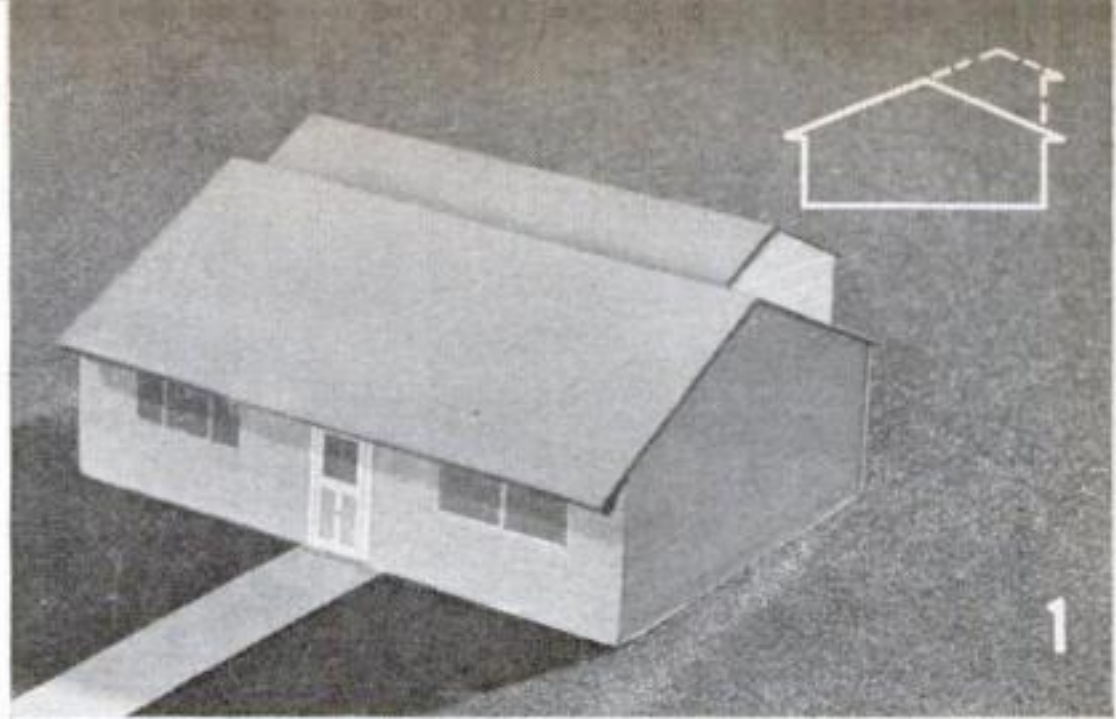
# A Ranch House CAN Grow Up

**T**HE popular ranch house has a special expansion problem. You can't add a dormer in the conventional way to use attic space. There's too little headroom—seldom more than 4' to 7' at the peak.

These Richheimer demonstration models show three ways of solving the problem. Where the peak is high enough, say 7', one side of the roof is extended upward past the original ridge to increase headroom (1), then is carried outward like a regular dormer. In the average house, this provides two new bedrooms and a bath.

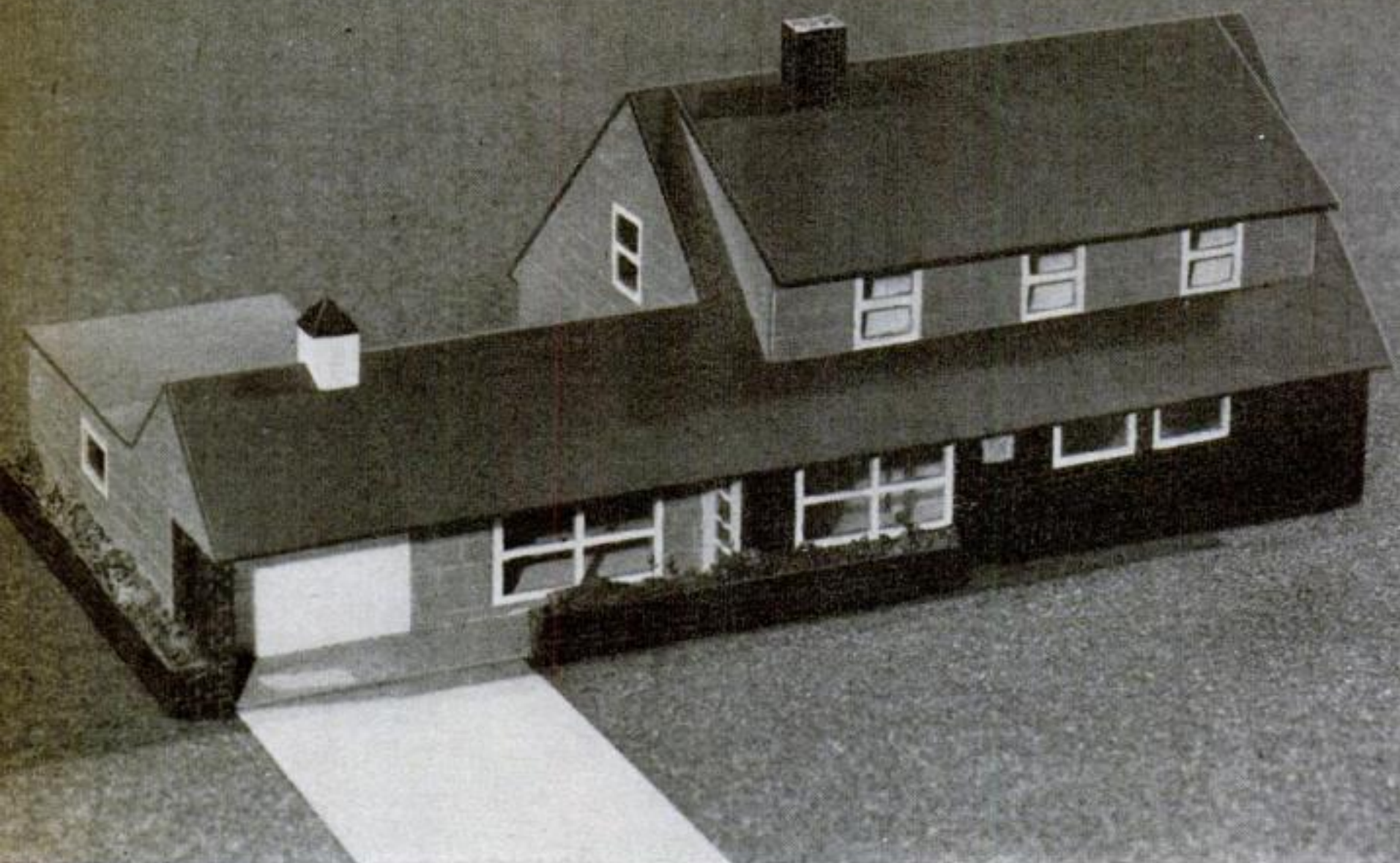
In very shallow designs, or where more rooms are needed, the entire roof is raised 3' to 7½' and supported on short sidewalls (2). The result: three or four new bedrooms and a bath. To gain even more space, Richheimer cantilevers the upper floor 2' out over the downstairs on each side (3). In a typical 32' house, this adds up to 128 square feet—equal to adding more than an extra 10'-by-12' room.

How much do you pay? On a 25'-by-32' house, you can figure about \$4,000 for a



single up-and-out dormer, \$6,000 to \$7,000 for a raised-ridge upstairs, and up to \$10,000 for the full cantilevered version. Is this expensive? "Not," says Richheimer, "when you consider what you'd pay for three or four bedrooms and a bath added on downstairs. And on a small lot, often the only way you can go is up." As a bonus, the raised-ridge principle also gives you a house that looks much bigger than the original.





**“**Two relatively inexpensive additions turn a little Cape Cod into this spacious home. The dormer added two bedrooms and a bath. Then we put on a garage, but used the space between it and the house for a playroom instead of an open breezeway. And look what you get.”

## Look How You Can Add Room to a Basic Cape Cod

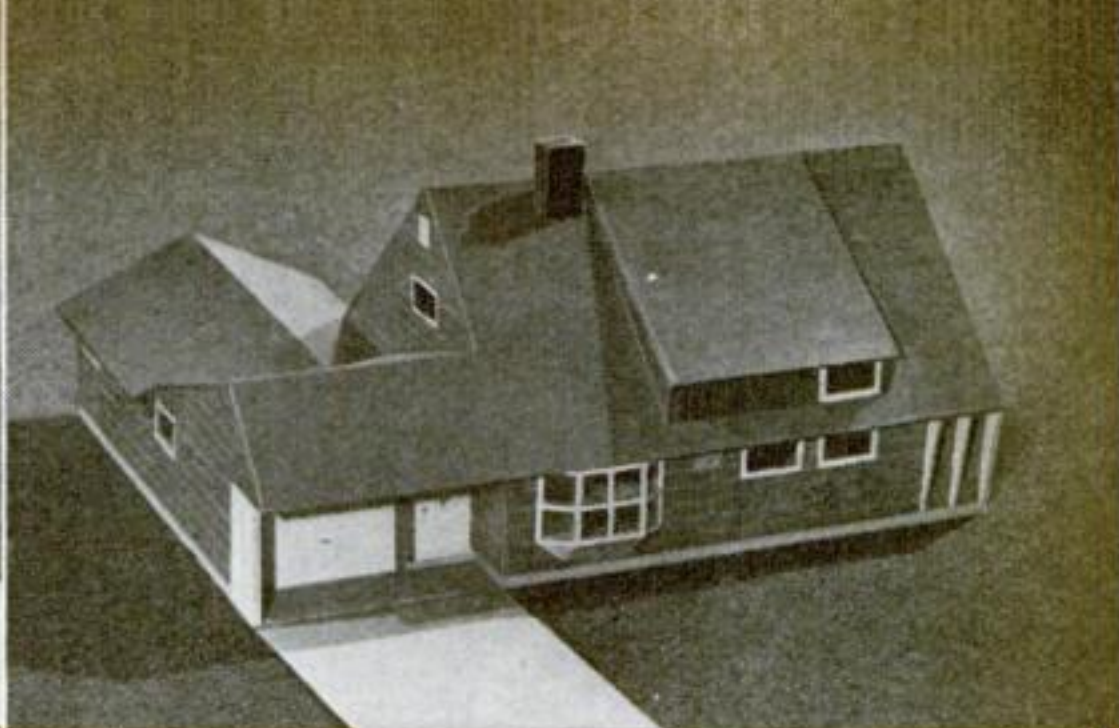
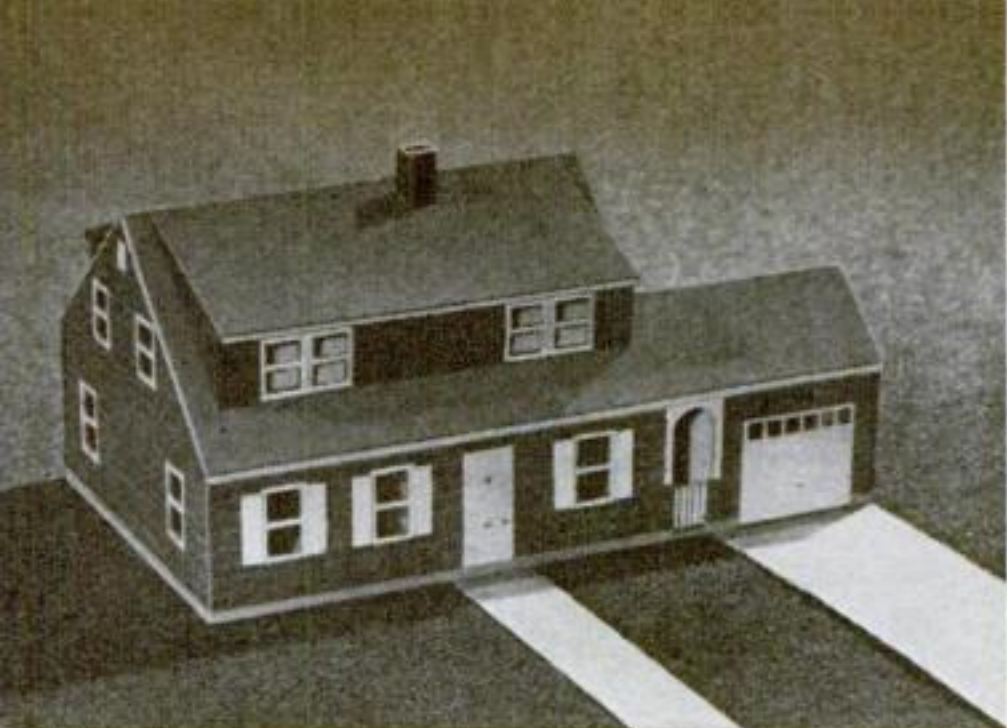
**“**Here we added a garage and put an upstairs over it and part of the house. This gives three bedrooms and bath, takes little space on narrow lot. The upstairs is cantilevered for more floor area. Note the style change—from Colonial to modern.”



**T**HE traditional steep-roofed home, more common in America than any other type, lends itself well to expansion. Its high peak provides ready-made attic space that can be turned into several rooms by merely adding a dormer. Side extensions that continue the existing roof line are an excellent way to add a longer, lower look to the original almost-square shape.

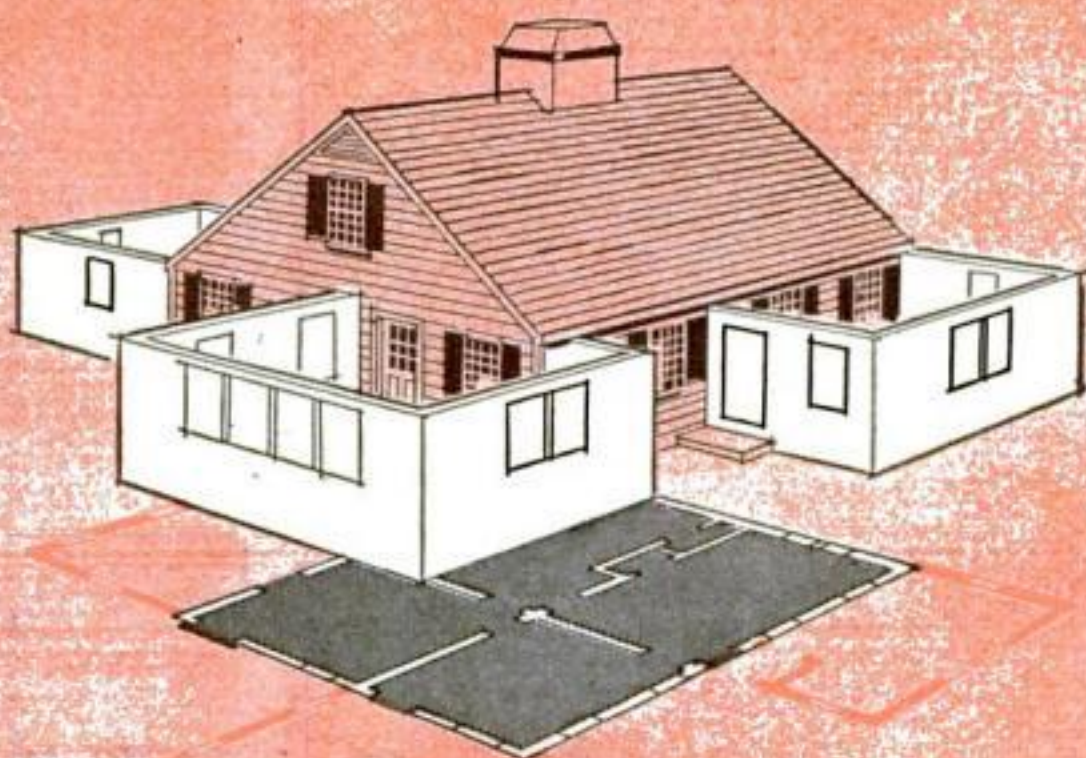
Here, Herbert Richheimer comments on four variations that all started out as the familiar little two-bedroom Cape Cod, typically about 25' by 32'. They prove that you don't need a mansion to have a spacious-looking home.





*“This one keeps its Colonial charm, while still almost doubling in living area. The two long shed dormers extending along the front and back give four rooms and a bath upstairs. The tiny arched breezeway between the garage and house adds a luxury touch but isn’t expensive.”*

*“Adding an extra-long garage is a good way to get space at the back for a den or shop without much added cost. Extending the front roof line over the garage ties it nicely to the house. That added bay window is really the kitchen. It gives an attractive appearance, doesn’t it?”*



## Will Adding One Room Solve Your Problem?

**O**FTEN a single room will give you all you need—that extra bedroom or long-awaited family room. Or you may want to add the space you need in stages, a room at a time. On the six pages that follow, nationally known architect Gerald K. Geerlings presents a score of plans showing where and how you can add either one room now or several progressively.

Where the plans shown do not exactly match your own house, they can be adapted by applying the basic prin-



ciples. Or it may be that by reversing the one shown you will find your own floor plan. On some of the plans, a narrow crosshatched area indicates a new 3'-wide hall stolen from an existing room.

This enables you to reach a new room without crossing a bedroom. Other plans show the new room opening off a living or dining room.

**For a score of ways to do the job, turn the page**





# Where to add a room to

By  
**Gerald K. Geerlings**

(Drawings by the author)

**I**F YOU live in a typical postwar two-bedroom house, very likely the floor plan is similar to one of the three shown in black on this page. The lines in color indicate how you might add a room at the front, side, or rear.

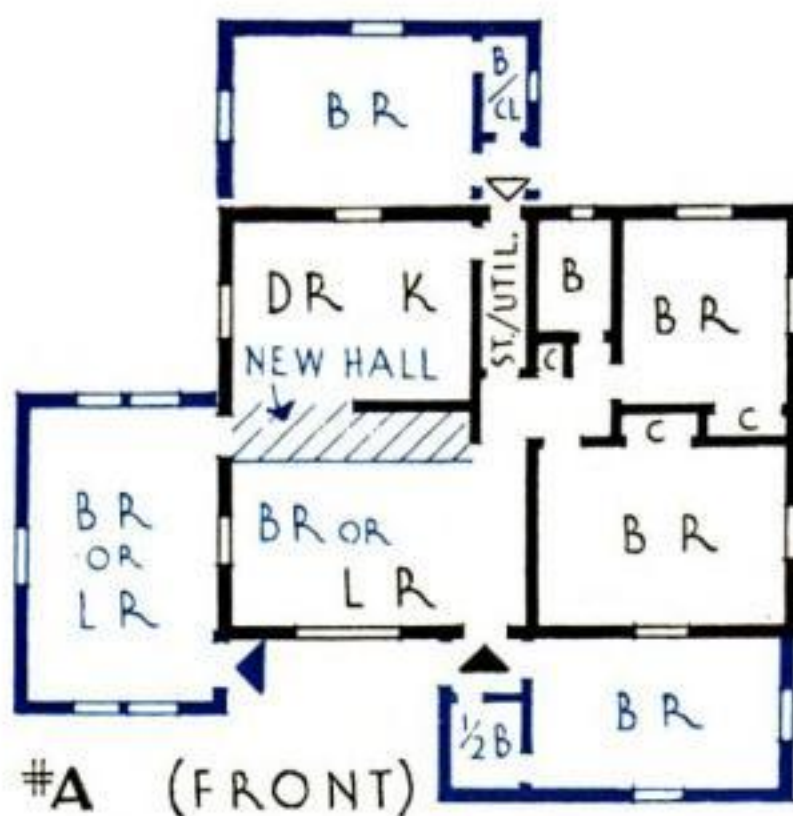
The top plan (A) is excellent. Living room, dining room, and kitchen are at one side, bedrooms and bath at the other. If the building code permits an addition on the front, this is a good location for a new bedroom, with or without a half-bath. The front door could remain as is, except that it would be desirable to have a vestibule in the addition to provide access to both the existing front door and the new room.

If your lot is wide enough for a new room at the side, this could be a new bedroom or living room. If the new room is to be the living room, the old one could be a bedroom or, if large enough, could be divided into two bedrooms. In the latter case you would want a new hall (shown crosshatched) to provide passage from the new living room to the existing bedroom hall and bath.

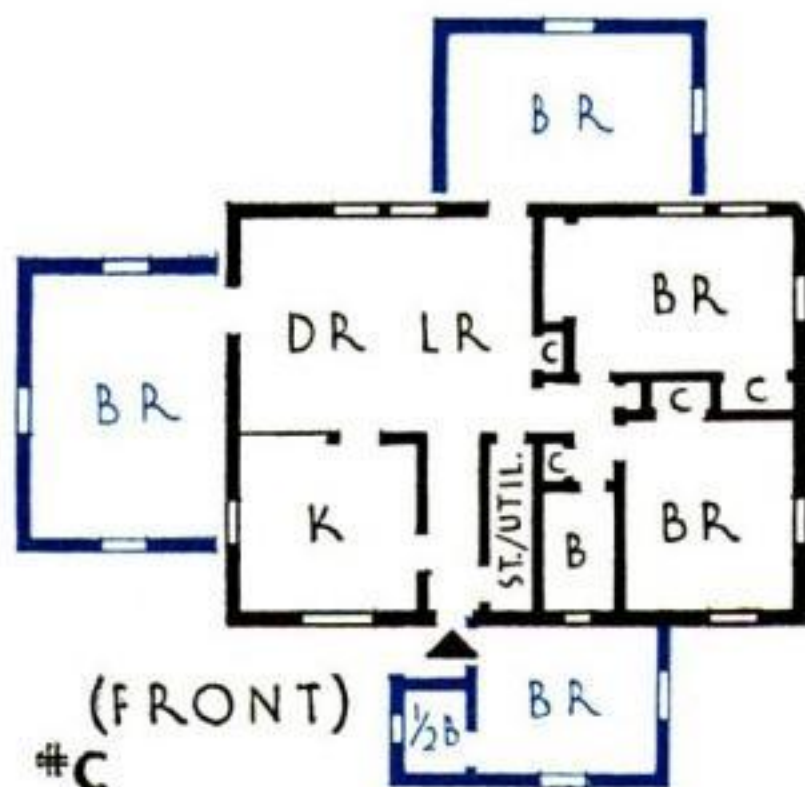
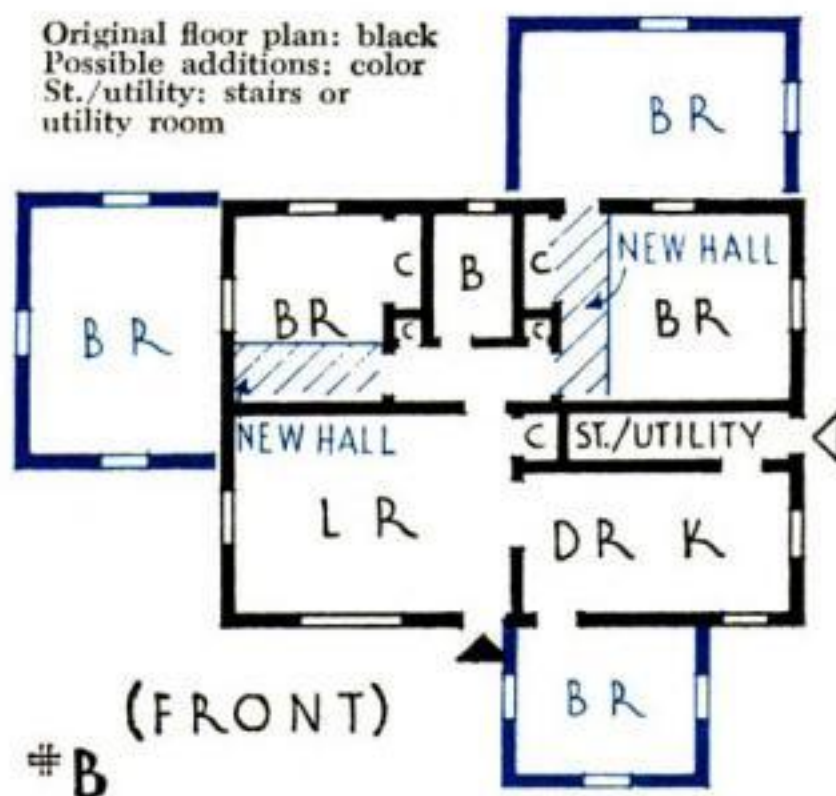
A new bedroom built at the rear could open off the kitchen-dining room or, better, off a vestibule at the rear door. A new half-bath off the new vestibule at the rear door would be desirable.

The middle plan (B) has the living room and kitchen at the front, the bedrooms and bath at the rear. If a new bedroom at the front has sofa-beds it could do double duty as a family room. Adding the new bedroom at side or rear is feasible if the existing rooms are large enough to be useful after giving up 3' to provide an access hall to the new room.

The bottom plan (C) has the kitchen at the front, living room at the rear, and bedrooms at one side. A new bedroom in any of the three locations won't require any new hall, providing there is no objection to having the new room open off the dining or living room (if the addition is at the side or rear).



Original floor plan: black  
Possible additions: color  
St./utility: stairs or utility room





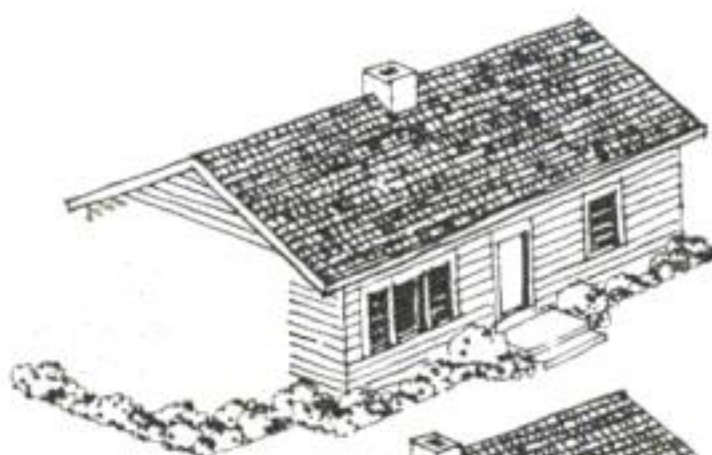
# 2-bedroom houses



What does your house look like? If it resembles the popular type of two-bedroom house above, floor plans on the facing page show how you might add a room at front, side, or rear. The three house drawings here depict a flat-roofed addition—the least costly. At front it could be enhanced with a decorative railing, at rear with a trellis covered with vines.



How to solve problems of a sloping roof is shown in these three sketches. At the front, the new roof intersects the existing roof because it is not as steeply pitched. At the side there is no problem. At the rear, the roof of the new room is merely an extension of the main roof, but it is given a flatter pitch, suited to a sloping site.



For the best-appearance, consider a gable roof with the same pitch as the main roof. It costs more than a flat or sloping roof, but many owners consider it worth the extra because of the improved appearance. A gable roof makes possible natural ventilation between ceiling and roof, insuring a cooler room in summer than is possible with a flat or sloping roof.





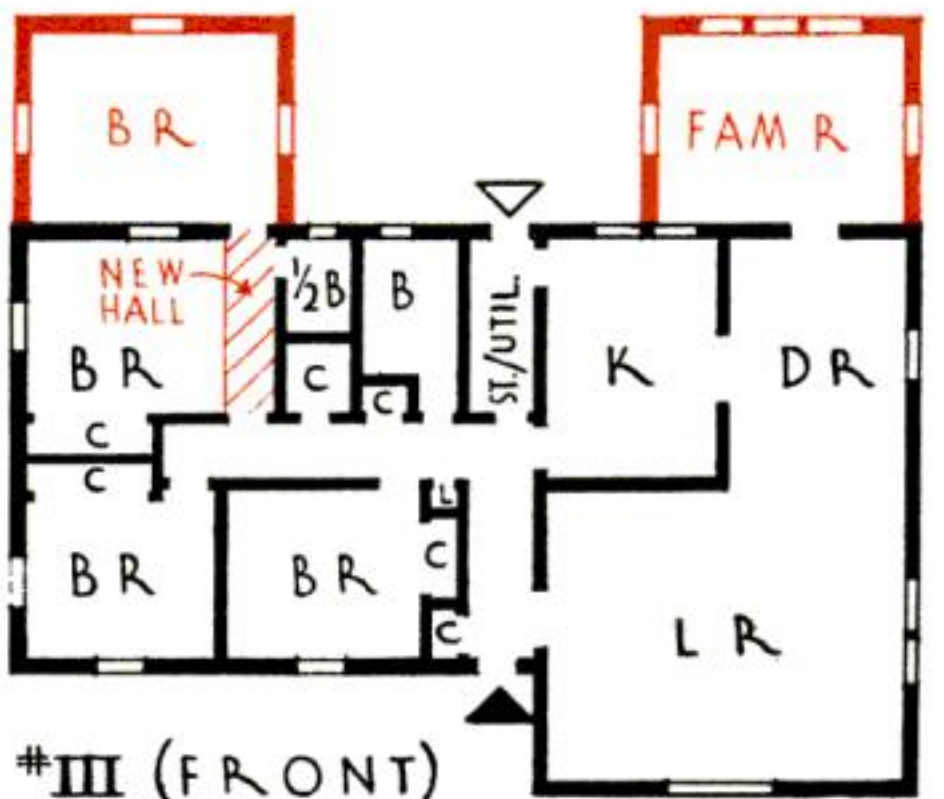
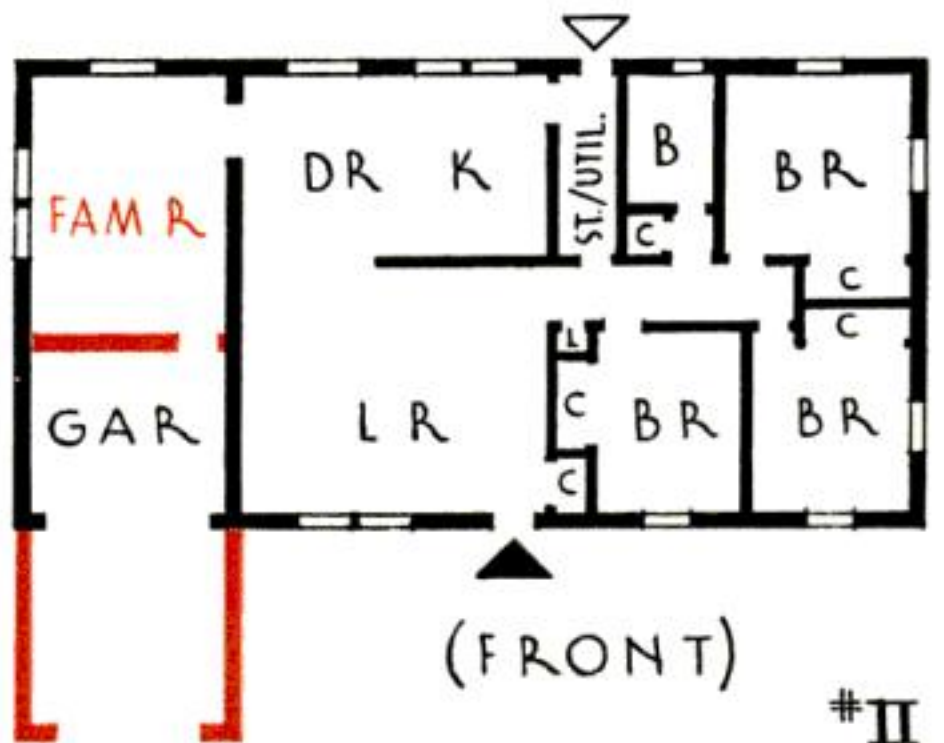
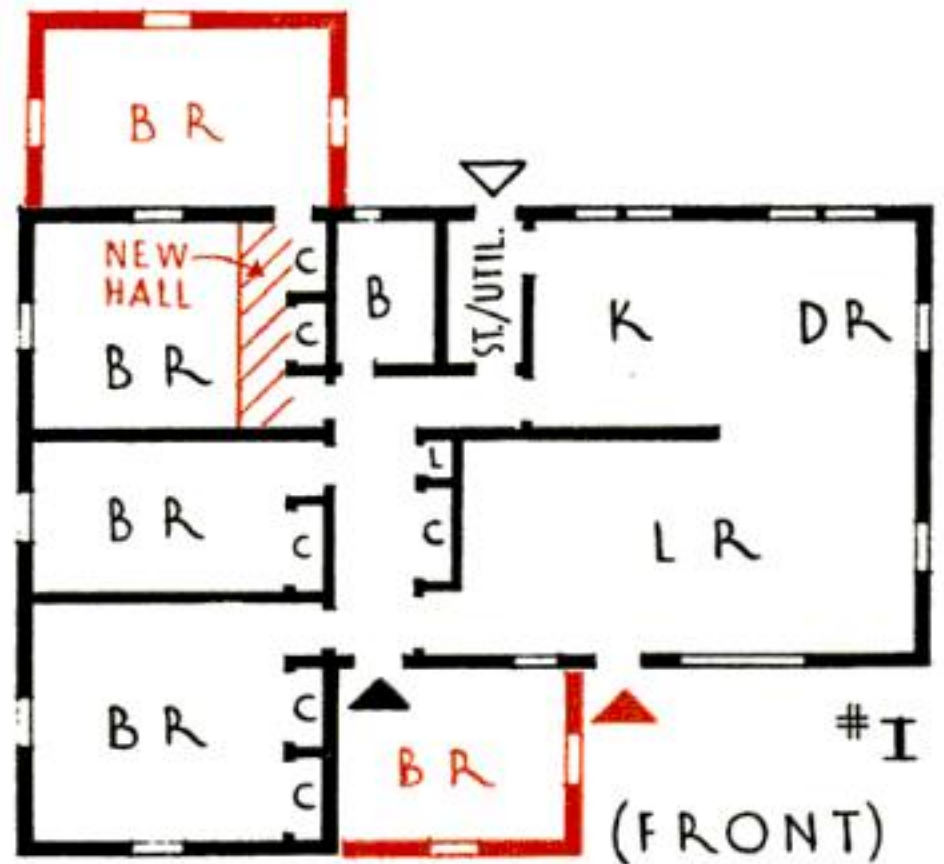
# Where to add a room to

THE three floor plans in black on this page are popular types of three-bedroom houses. If you are planning an addition on such a house, first determine your most urgent need—bedroom, family room, den, or other space—and then where the room should go. The final result may be a compromise, but by ingenious planning you can obtain double usage from floor space, such as a dual-purpose bedroom-family room with a fold-away bed or sofa-bed.

The top plan (I) is the L-type. It has bedrooms along the side that projects toward the front, and a hall between them and the living-dining-kitchen area. In this room sequence a bedroom can be added at the front, with a new front door opening directly into the living room. Adding a bedroom at the rear may be even better, but a 3'-wide hall (shown crosshatched) will diminish the size of the existing bedroom at the rear of the house.

Many three-bedroom houses have a rectangular plan (like II), with a garage at one end. If the lot is not wide enough to permit an addition at one side or the other, a family room (or bedroom) can be readily made by using the rear part of the garage. To compensate for the amount of garage floor space used for a family or bedroom, the building code may permit you to build a garage extension toward the street (as shown in color). If you can't build toward the front, extend the new room from the rear of the garage. You can provide access to it by converting a rear corner of the garage into a small hall leading to the addition.

The bottom plan (III) represents a third popular type of three-bedroom house, with the living-dining-kitchen area at one side, projecting forward from a rectangular area with bedrooms and bath. The best location for either bedroom or family room in this plan is usually toward the rear. A 3'-wide hall (shown crosshatched) may have to be taken from the floor space of the existing bedroom. The suggested family room is shown opening from the dining room, but in addition you may want an exterior door to the rear garden. In the interests of economy, plan to re-use windows and doors removed from existing rooms.





# 3-bedroom houses



FRONT

On an L-shaped house of one story, how can an addition to the front be made in the corner of the L without ruining the appearance? A gable roof creates too many valleys, and a sloping roof might look unpleasant. The best and least costly solution for a house like that shown above is to use a flat roof with a decorative railing (left), and install a new front door.



REAR

An added room at the rear of an L-shaped house (like the one at top of the page) will look like part of original design if roof is the gable type, having the same slope as existing roof. Install thick insulation in the ceiling.



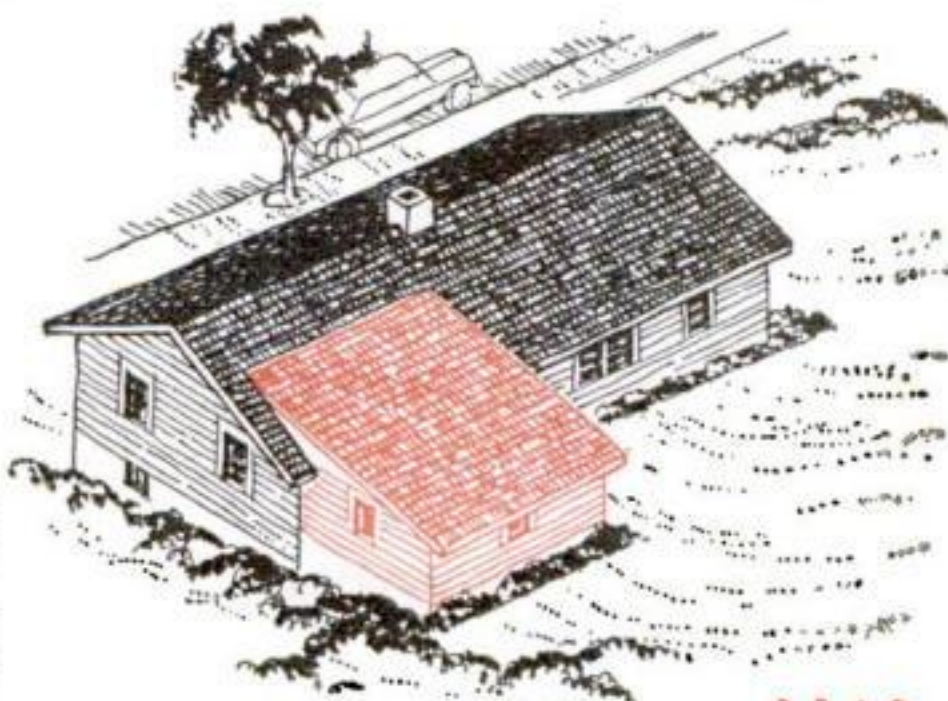
FRONT

Pushing out to the front is explained in middle plan (II) on opposite page. Garage is partially extended toward front, with a flat, or almost flat, roof. Side wall could be dressed up with vines and contrasting-color lattice.



REAR

An addition at the rear may pose a problem if the ground slopes *down* from the street. In this scheme, the floor level of the addition drops several steps below the main floor. The roof is the economical sloping type.



REAR

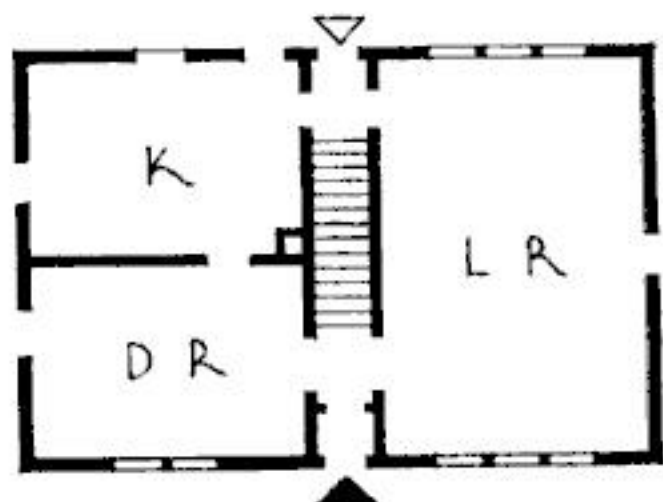
Lot sloping upward from the street? You can still add room at the rear of your house. This sketch shows the floor level raised several steps above that of the existing house. The roof of the addition slopes slightly.





# Where to add a room

The plan at left represents the central-stair, Colonial house, which is still hard to beat. The second floor usually has three or four bedrooms and a bath. The first floor lends itself to adding a room at either side (depending upon lot size and building code), or maybe preferably toward the rear. Suggested locations for a new room are shown in color.



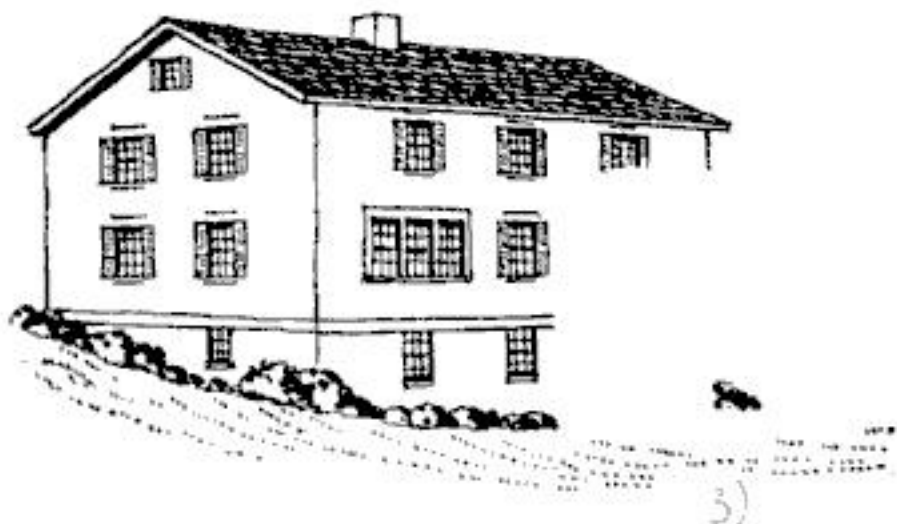
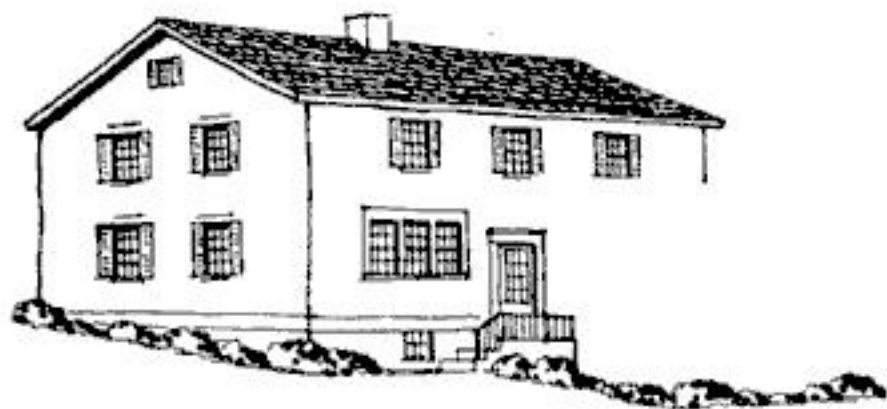
The sketch at the top of this page shows the characteristic Colonial house from the front. The upper drawing at the right also shows the same view but with an addition at the side in color. The addition can be in keeping with the existing house, and usually presents no problems. The roof can be flat or sloping.



(1) REAR

**T**HE addition of a family room at the rear has distinct advantages. It is convenient to the kitchen for serving snacks and supervising children, and it is useful in combination with the rear garden for indoor-outdoor living. The new room could have a flat roof, useful as a sun deck and accessible from one of the bedrooms.

Your lot may not be level, perhaps sloping down from the street. The upper drawing at left shows a gentle slope. It may save money and improve access from the garden if the floor level of the new room is several feet lower than the existing first floor. The lower drawing to the left shows a steeper slope, with the new room at the same floor level as the existing first floor. Such a room can be supported on masonry piers, steel columns, or sturdy wood posts.

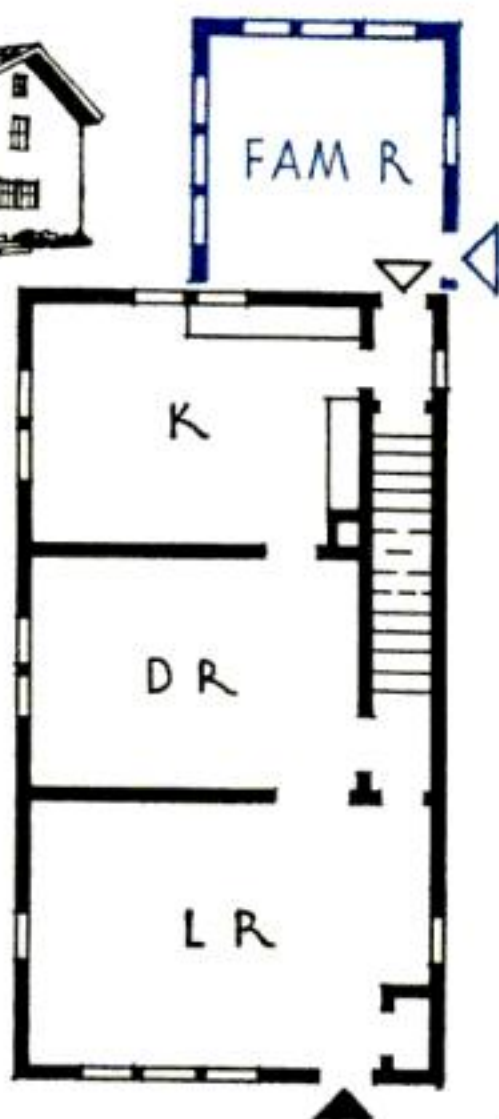




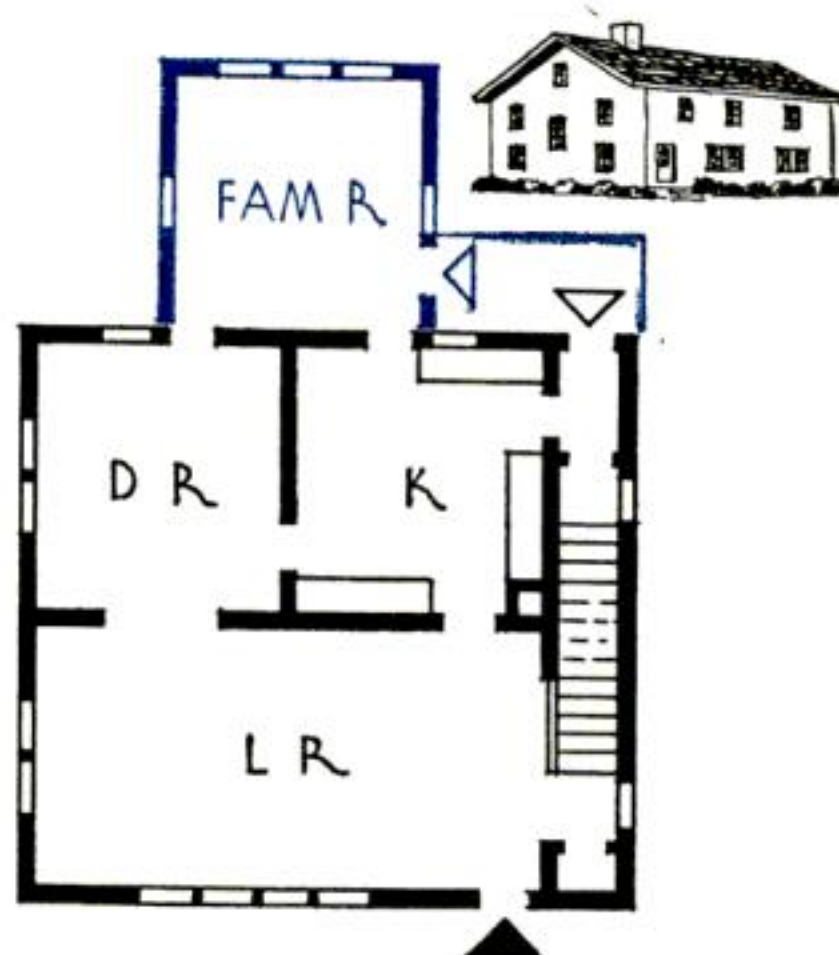
# to 2-story houses



The plan to the right is typical of many prewar two-story houses built on narrow lots. A new room could best be added at the rear, including a new exterior door. The location of the latter will depend on your lot. A new bath would improve the livability of the new room, whether used as a family room or bedroom. Second-floor space could be enclosed here, too.



The sketch at the top left represents a common type of two-story house on a narrow lot, as seen from the rear. The drawing below it shows an added room, viewed from the same angle. If the materials and appearance of an existing house are outdated, an addition may be better if built with contemporary materials and ample glass areas. A separate door to the rear garden might help make the new room the most used and useful in the house. By using a sofa- or fold-away bed the addition could serve not only as a bedroom for one of the family who retires late (or to accommodate an occasional guest), but would function as a junior living room as well. The roof could be flat, with overhead structural members to support awning and screening—a wonderful place to sleep on hot nights.



Another common two-story house plan is shown above. These houses are often on a narrow lot; hence a new room might have to go at the rear. The new family room shown is located where it won't cut off all the natural light in kitchen and dining room. Exterior door is optional.

If you have the type of house at right, perhaps a bedroom is more essential than a family room. Here, too, the new room could be planned to be equally adaptable for both day and night uses. Or, if you prefer starting the addition as an open porch, build the structural members so that it will be possible to use stock windows and doors if later you decide to enclose it.

The floor plan shows a new little open platform at the rear door to provide access to both the existing rear door and a new door to the new room.

The roof is flat to make this space usable as a sun deck, or later on as a screened porch, or, at a still later stage, as an enclosed bedroom. Another possibility is to build the first floor as a porch, and enclose the second floor as a bedroom.



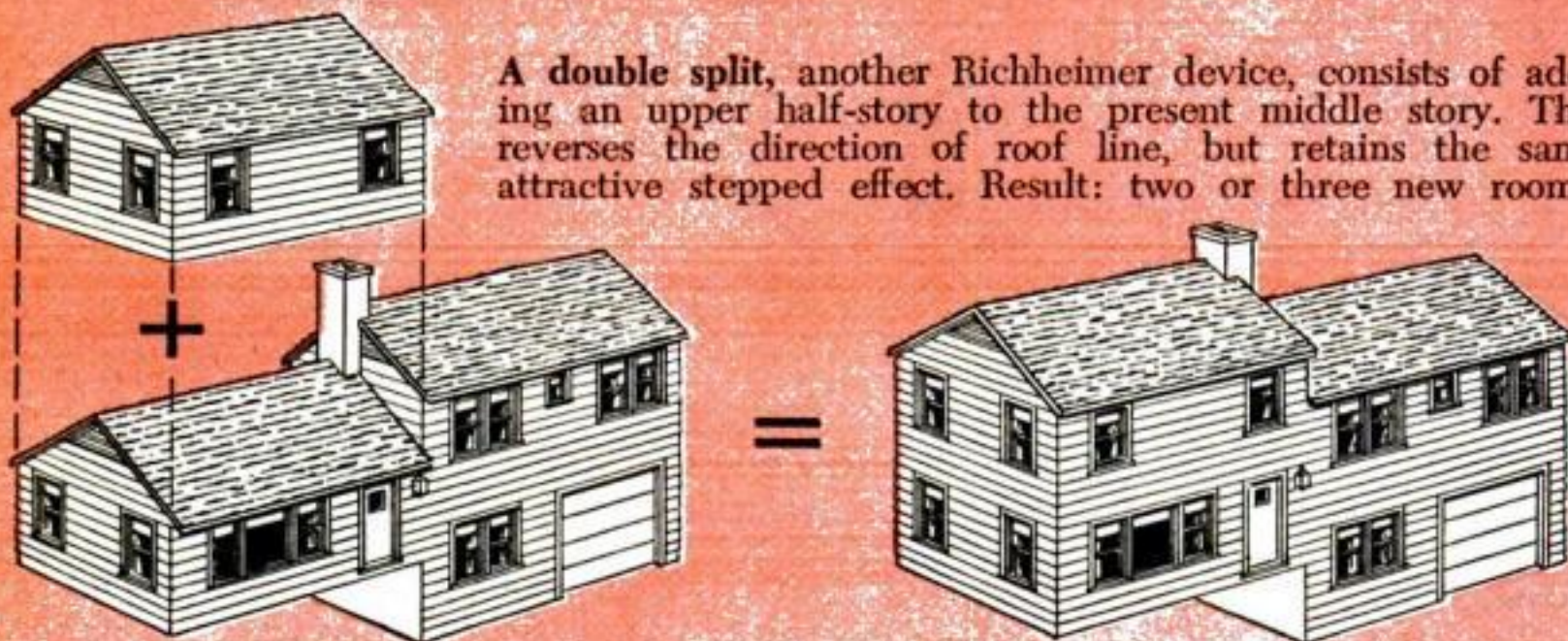


## Two Ways You Can Enlarge a Split-Level



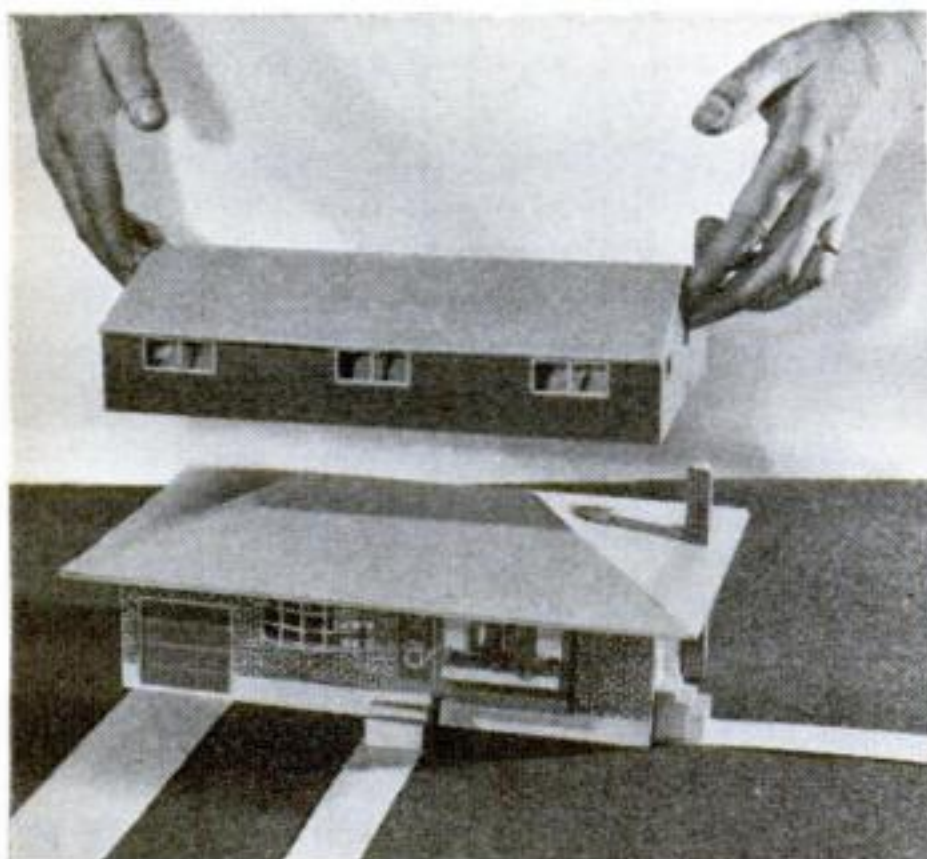
Upper story of a split can be extended out over an existing garage, a trick used by remodeler Herbert Richheimer. Where no ga-

rage exists, a two-story addition can be put on, giving a similar result. Note how new roof follows original to keep same look.

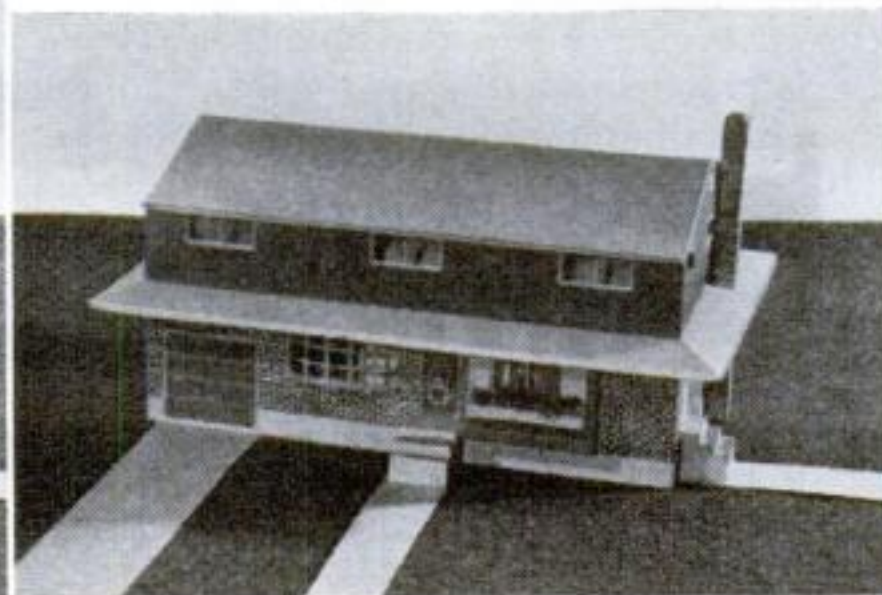


A double split, another Richheimer device, consists of adding an upper half-story to the present middle story. This reverses the direction of roof line, but retains the same attractive stepped effect. Result: two or three new rooms.

## Adding a Second Story to a Hip Roof



Often considered a problem, the hip roof is easier to expand than it looks. The lack of headroom caused by the inward-sloping rafters is overcome by putting a new roof over short side walls. New roof line harmonizes well with parts of hip that still show.





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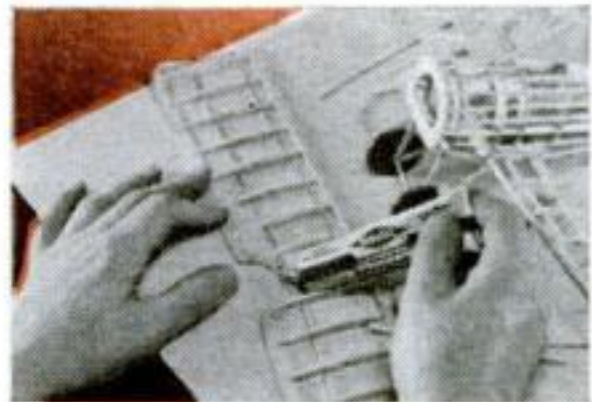
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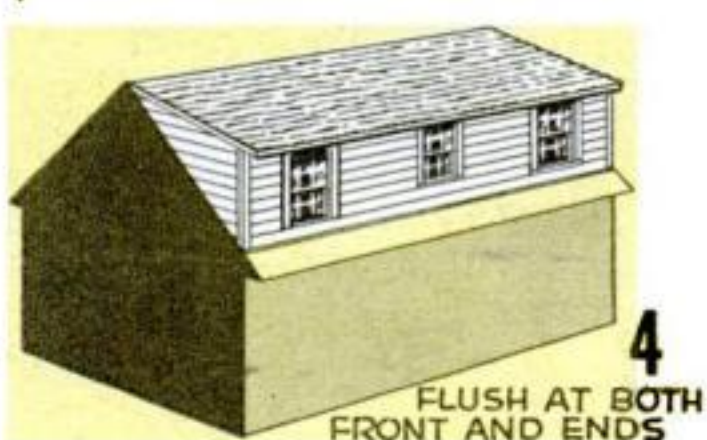
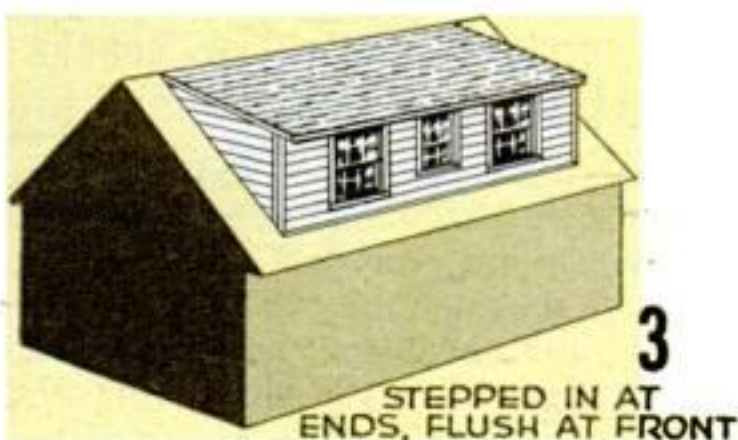
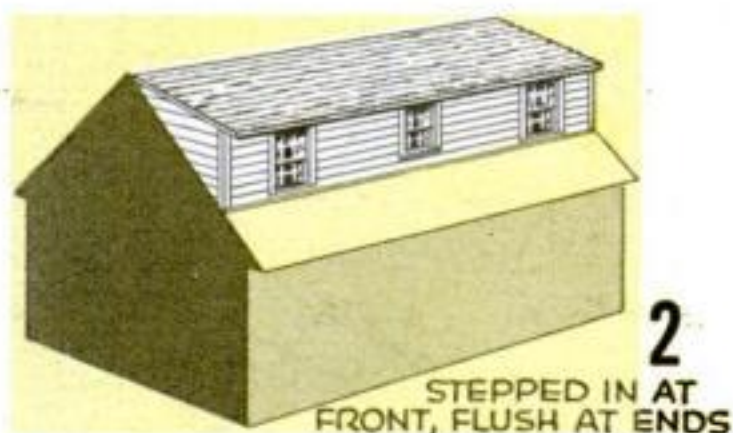
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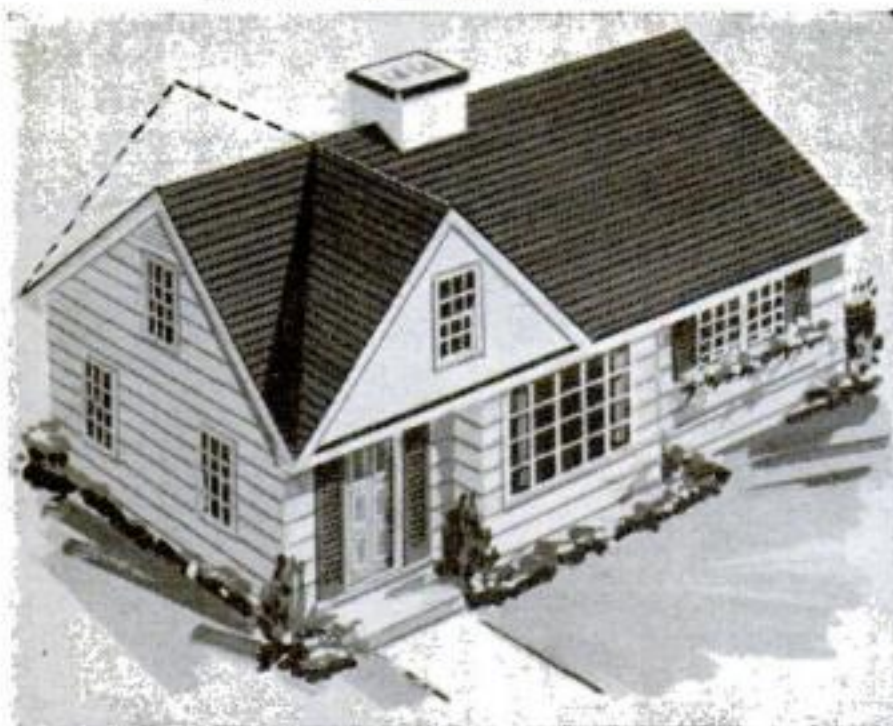


## How four styles of shed dormers affect both space and looks



The bigger the dormer, the more you gain in space but lose in beauty. Fully stepped-in style (1) is considered most attractive, but sacrifices 1½' in front and 2' at each end. Of the two partially stepped-in types (2 and 3),

the flush-front design (3) gains most space on a long house, also retains pleasing end setbacks. Full-flush type (4), usually used only in rear, typically adds 60 to 70 square feet more, but is least attractive.

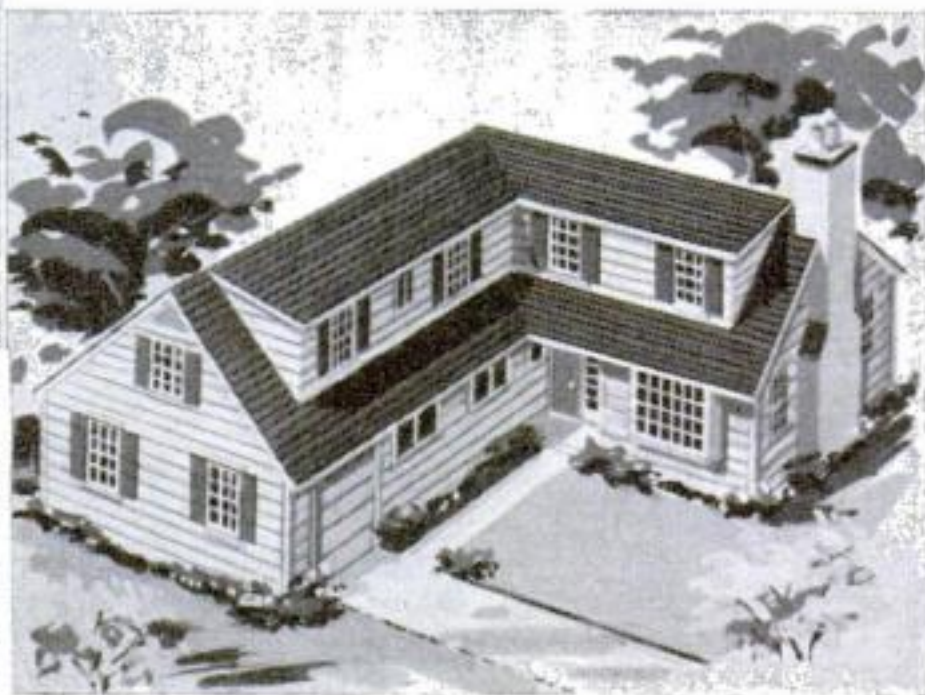


**5** Gable dormer gives less headroom than shed type, but is sometimes used to add a distinctive touch. It often makes a small house look bigger by suggesting it turns a corner.

**6** On an L-shaped house, this two-way dormer gains headroom in both directions, eliminating the space-wasting corner. Note that it still preserves most of the original roof line.

## 6 Dormers

There's a dormer to suit both the space you need and the style of your home







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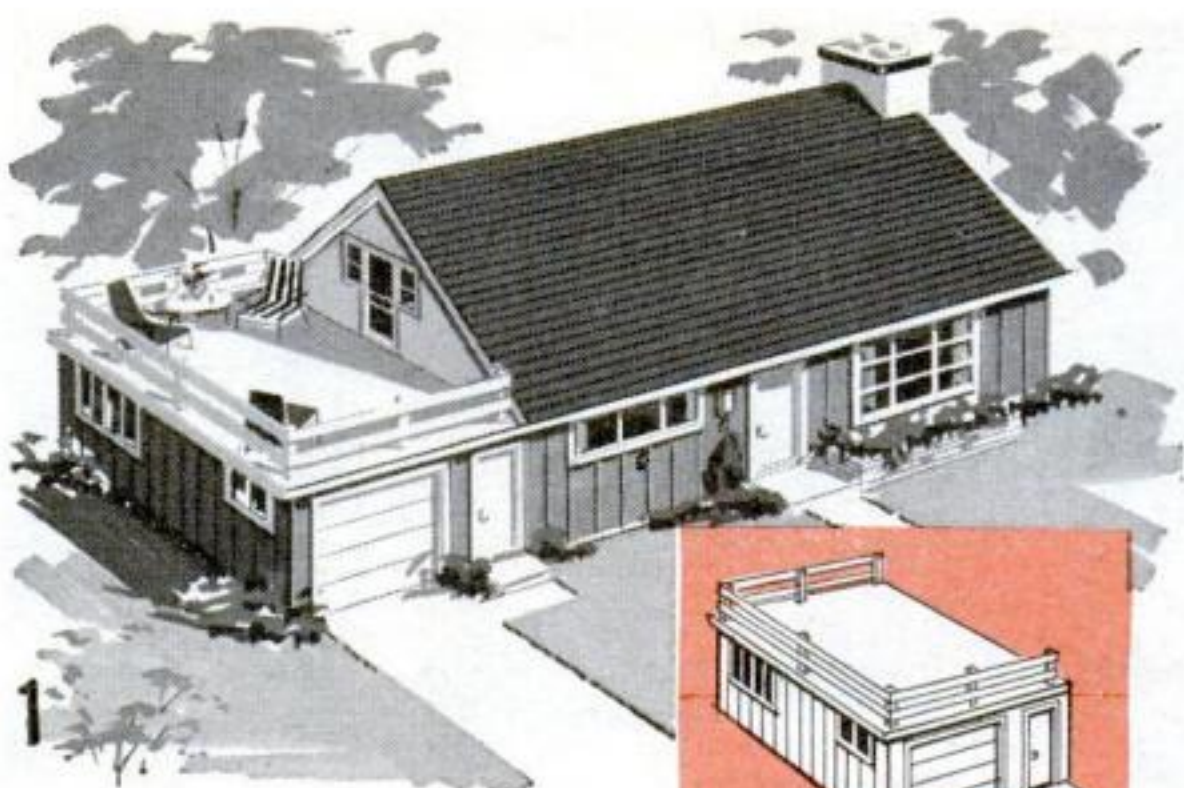
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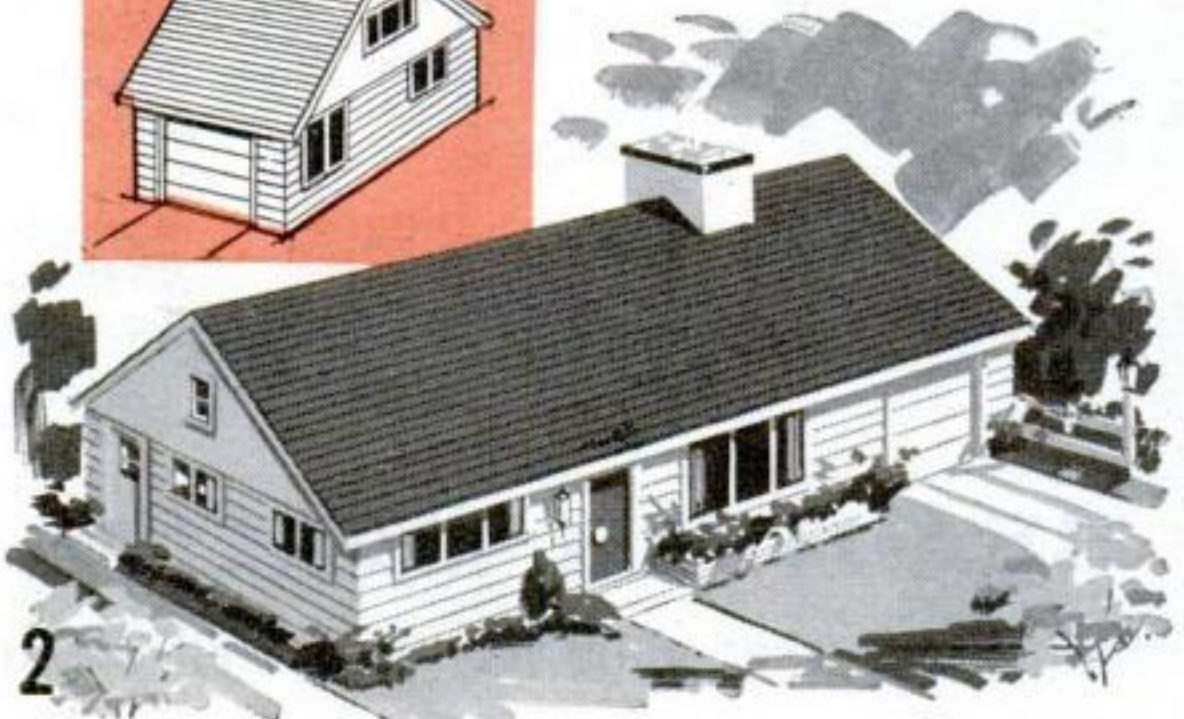
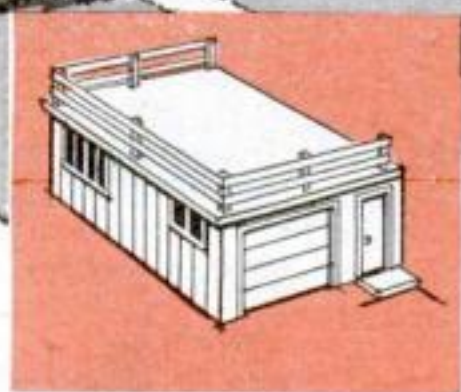


# Consider the Garage when you need living space

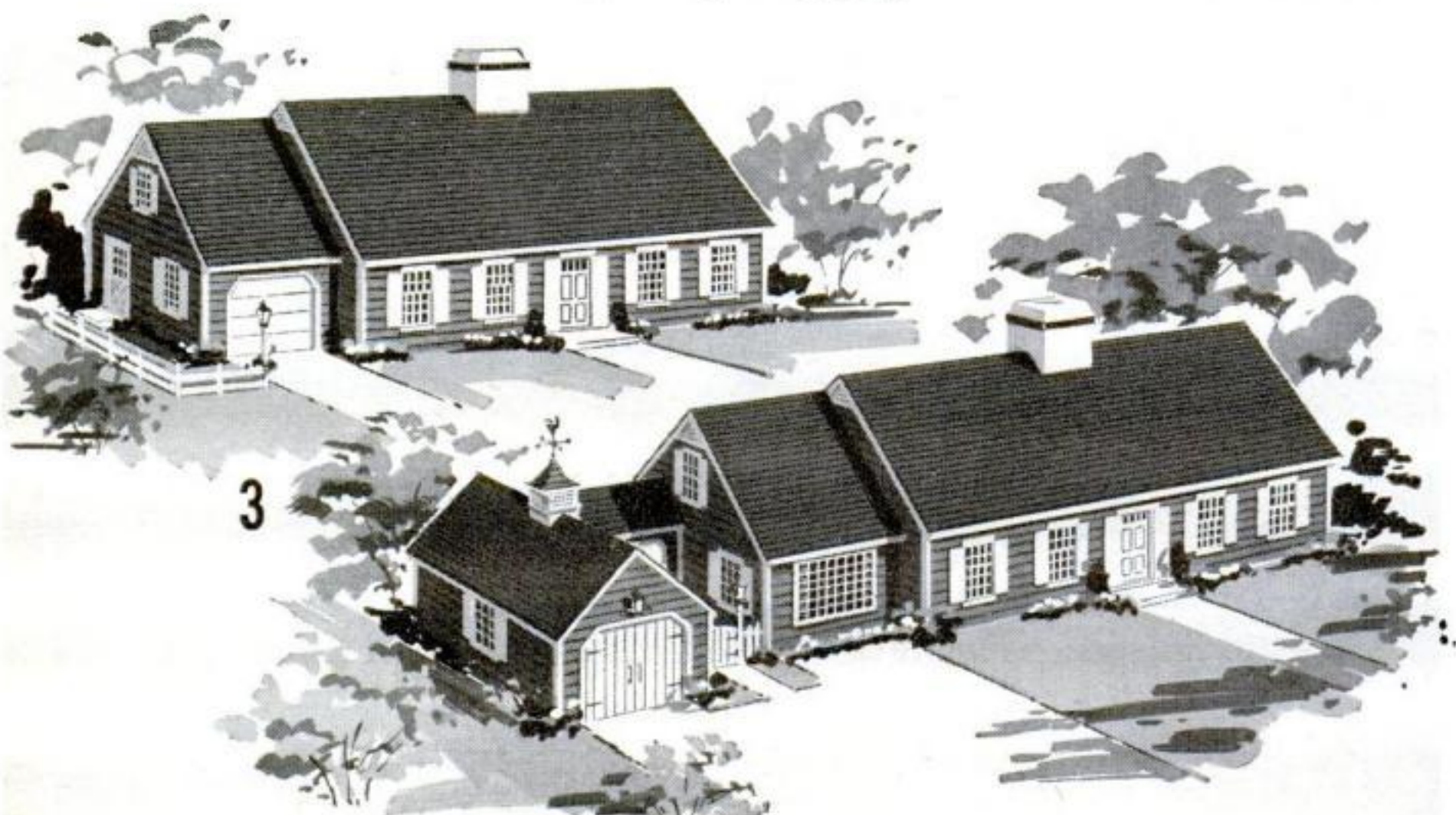
**O**FTEN you can gain both a garage and extra living space by combining them in a single addition—for only a little more than each would cost by itself. Here a deep, flat-roofed garage (1) provides space in back for a small bedroom, den, or shop, plus a sun deck. You can also add a room over a garage (2). Or it may be possible to convert an existing garage into living space you need now (3), and add another garage later.



1

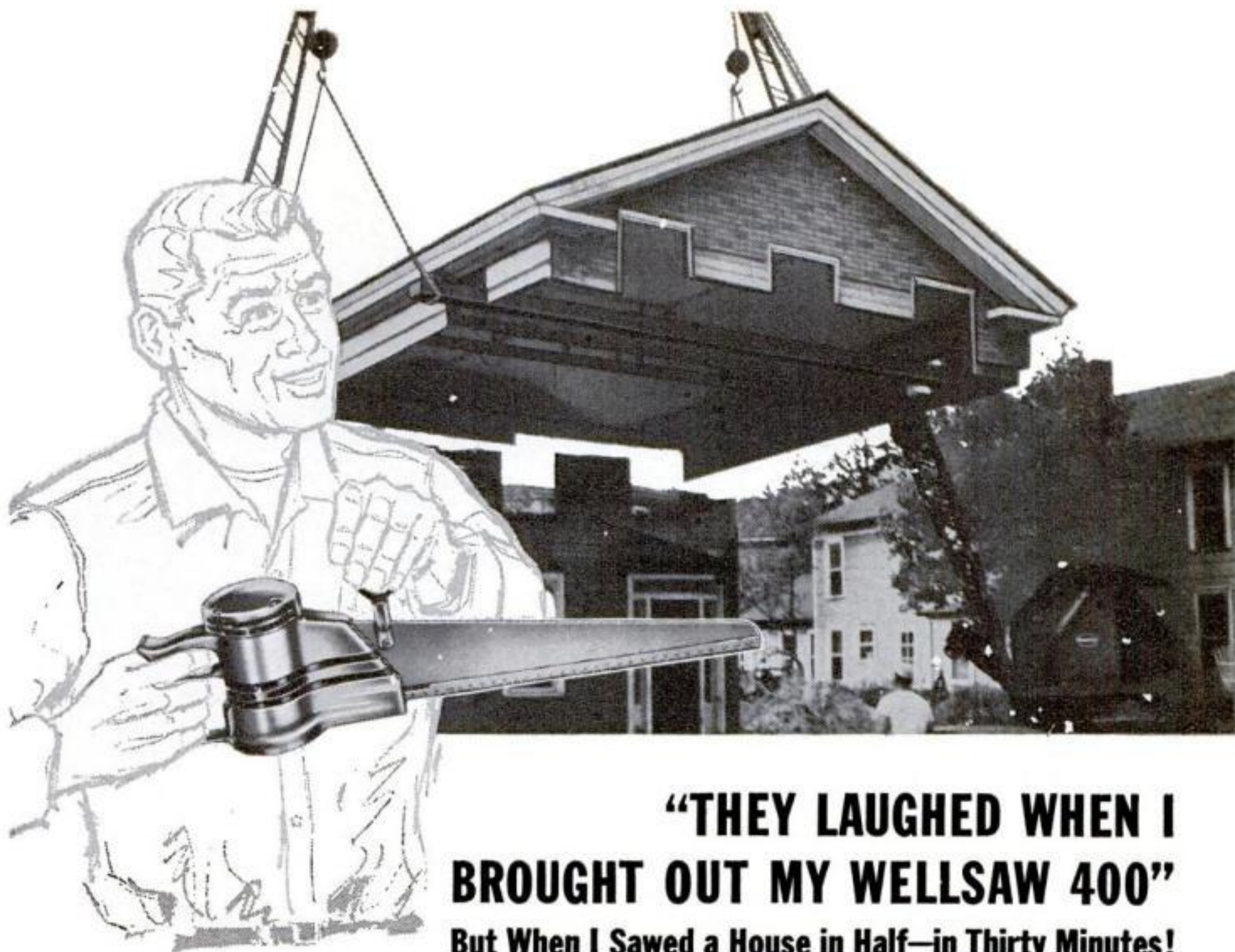


2



3





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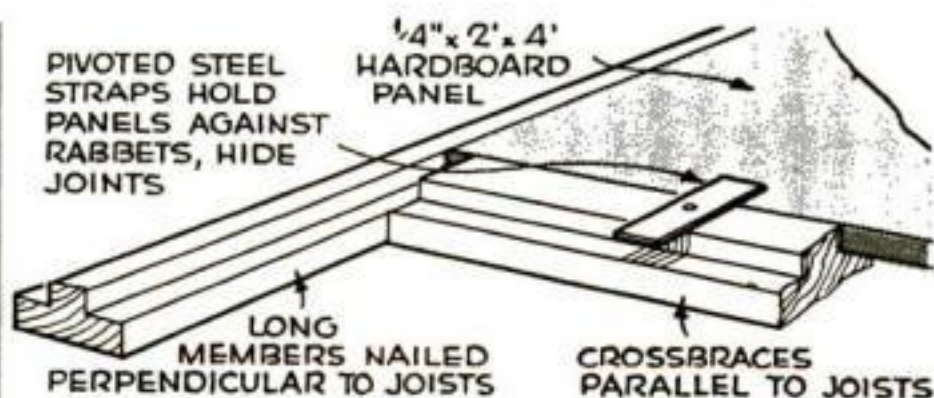
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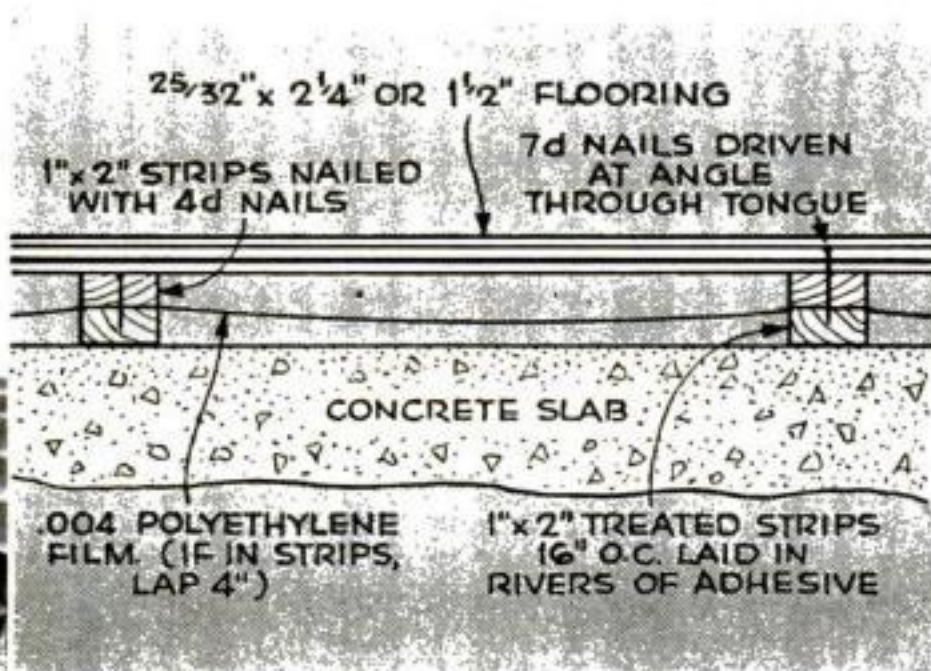
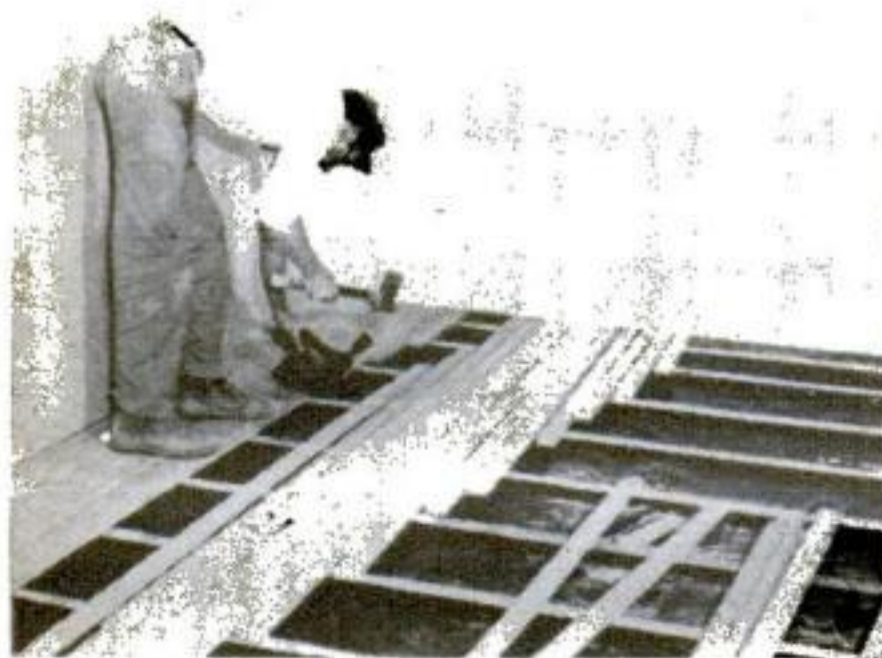
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# **Choosing the Right Building Materials**

**S** ELECTING materials for an addition? It's always a sensible rule to follow the precedent of the existing house, especially in the choice for exterior walls.

Materials are listed below about in the order they would be installed on the job. In the listing, the numeral 1 indicates the material that normally will be least expensive. Other numbers follow a rising cost scale—the higher the number the more expensive the material. If your addition requires a material not on the list, ask your builder for the cost range.

## **Exterior walls**

(1) Exterior-grade plywood, siding, and shingles are all about the same cost when labor is included; (2) prefinished siding or pre-dipped shingles; (3) redwood siding; (4) hand-split shingles; (5) asbestos-cement siding or sheets; (6) aluminum siding; (7) 1"-thick brick veneer nailed in place; (8) 4" brick veneer; (9) 4" stone veneer.

## **Insulation**

(1) Insulating sheathing  $\frac{3}{4}$ " thick; (2) fiber type in batts in thickness of 1", 2", and 3"; (3) comparable prices for aluminum-foil type with 1, 2, or 3 air spaces. Additional type used in pellet form and poured between joists of topmost ceiling.

## **Materials for pitched roofs**

(1) Asphalt type, priced according to the weight given for 100 sq. feet; (2) asphalt type with self-sealing adhesive; (3) machine-cut wood shingles; (4) hand-split wood shingles; (5) asbestos-cement type with simulated wood grain; (6) slate or tile.

## **For flat roofs or sun decks**

(1) Built-up roofing (if to be used for sun deck, "duck boards" are needed); (2) heavy quality canvas made for the purpose; (3) tin; (4) copper.

## **Roof ventilation**

(1) Vents in gable ends or on sloping faces of hip roofs; (2) continuous screened openings along eaves; (3) continuous type along ridge.

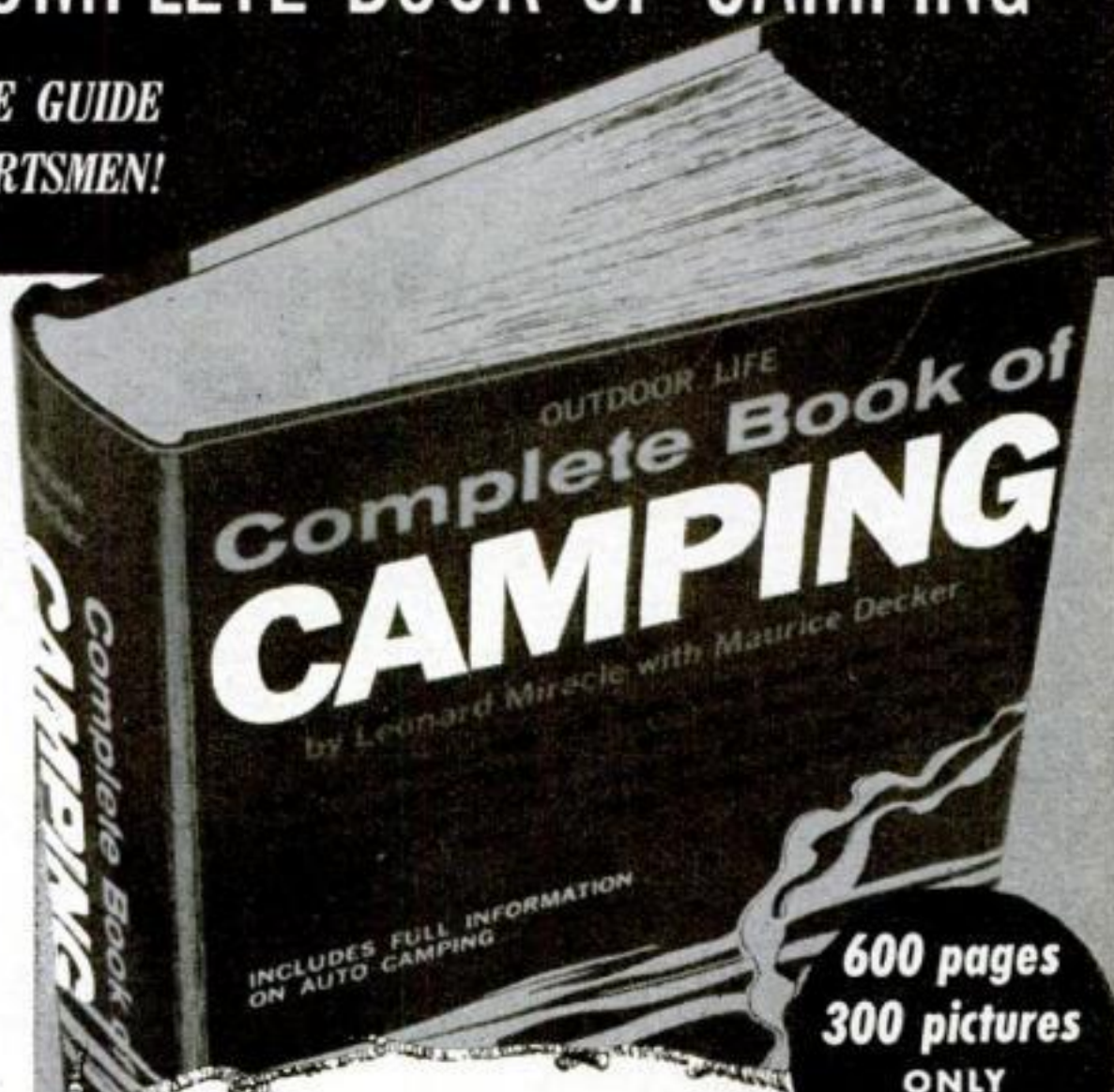
## **Gutters**

(1) Wood or galvanized iron; (2) aluminum; (3) copper. (Downspouts use the same materials.)



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## Interior walls

(1) Wallboard  $\frac{1}{2}$ " thick ( $\frac{3}{4}$ " okay for ceiling if joists are 16" on centers); (2) wallboard with aluminum foil on back as vapor barrier; (3) wallboard with special surface such as treated paper to look like wood grain, fir plywood; (4) selected plywood sheets unfinished; (5) same as previous but prefinished; (6) plywood paneling of various selected woods, unfinished; (7) same as previous but prefinished; (8)  $\frac{3}{4}$ " wood boards, unfinished; (9) same as previous but prefinished; (10) prefinished wood panels with laminated plastic protective coating.

## Interior doors

(1) Flush type, of lauan mahogany; (2) flush, of various grades of hardwood.

## Closet doors

(1) Hinged; (2) sliding; (3) folding.

## Windows

(1) Double-hung; (2) fixed; (3) sliding; (4) awning or hopper; (5) casement. (Note: The gap between wood and aluminum window prices varies from locality to locality.)

## Flooring

**Wood.** (1) Yellow pine; (2) strip oak; (3) parquet blocks; (4) random-width oak.

**Sheet material and resilient tile.** (1) Linoleum; (2) asphalt tile; (3) vinyl-asbestos; (4) cork; (5) rubber; (6) solid opaque vinyl; (7) solid translucent vinyl.

**For a masonry slab.** (1) Cement with integral coloring; (2) terrazzo; (3) quarry tile; (4) ceramic tile; (5) marble cut into tiles.

## Kitchen cabinets

(1) Knock-down and assembled on job; (2) stock and assembled at factory, unfinished; (3) same as previous but prefinished; (4) same as previous but with laminated plastic fronts.

## Some general guidance rules

Using the above listings and the services of a reliable builder, determine first what your addition would cost if you used only materials in the lowest-cost category. To this best-guess estimate, then add a reasonable financial cushion for the unexpected. When you build, nothing is more certain than unexpected costs. Only when you have made certain of meeting the total cost can you safely toss out an economy material for that walnut paneling, random-width flooring, or other quality material you'd like to have.

There are four items where you should never skimp—termite protection, insulation, vapor barriers, and effective roof ventilation. Termites cause costly damage, yet they can be kept out for a very modest sum. The top row of cement blocks forming the foundation wall should have all holes filled with concrete. Lumber pressure-impregnated with chemicals should be used for all sills, beams, and joists over a crawl space.

Insulation is one of the best dollar investments you can make. Fuel savings will probably amortize the insulation costs within five years. Use enough to do an efficient job and you will get full use of each room, right up to the outside walls, in the severest weather.

A vapor barrier should cost only \$10 to \$15 for a single room. Wallboard with aluminum foil on the back is one method. Another is batt insulation with impregnated paper or aluminum foil on one side, the latter to be installed toward the inside of the room. A third method involves stapling thin sheets of plastic, aluminum foil, or copper foil over the studs after the insulation has been installed.

—Gerald K. Geerlings





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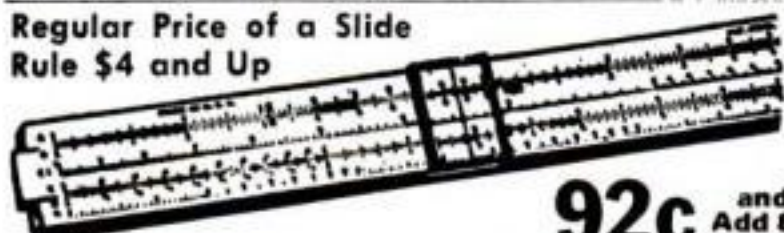
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## For that new room: "Where Can I Get the Money?"

**O**NE answer may lie in an important new FHA lending program that goes by the name of 203K. If you qualify, you may be able to borrow up to \$10,000 and take up to 20 years to pay it back. The interest is a simple six percent *true* rate, unlike the discount rates on short-term loans that actually cost you almost double in true interest.

The big advantage: Under 203K, you pay \$7.58 a month for each \$1,000 borrowed over 20 years, compared with \$20.79 a month under a regular five-year home-improvement loan. A \$3,500 addition would thus add only \$26.54 to your present monthly payments.

There are strings, of course. The actual amount you can borrow depends on your income, credit rating, and property value. The loan, plus what you still owe on your present mortgage, can't exceed the total mortgage value of your home with the improvements. Improvements must be major structural changes, not simple fix-up jobs or luxuries like swimming pools.

So far, the 203K plan, still in its first year, has been slow to catch on. Many banks have been reluctant to lend under it because of its lower interest yield. Remodelers expect the picture to brighten, however, as the plan's advantages in spurring home improvement become more widely recognized.

In the meantime, if you aren't able to get one of the new loans, here are other ways you can borrow money:

**Conventional home-improvement loans.** These are available from most banks and other lending institutions either with or without FHA insurance. On FHA-backed loans, you can borrow up to \$3,500 with up to five years to repay at a five-percent discount rate. On non-FHA loans, you may swing up to \$5,000, but the interest may be higher. Some contractors will arrange a loan for you, saving you the bother.

**Personal loans.** These can be used for improvements, and usually the bank isn't as fussy about how you spend the money. The maximum loan is generally \$5,000 at a six-percent add-on rate (slightly less than a discount rate). The disadvantage: You'll be expected to pay back quickly—within three years.

**Installment buying.** You can often buy materials from lumberyards and building-supply houses on a time-payment plan. The disadvantages: Interest rates are likely to be high, repayment periods short—usually one to two years.

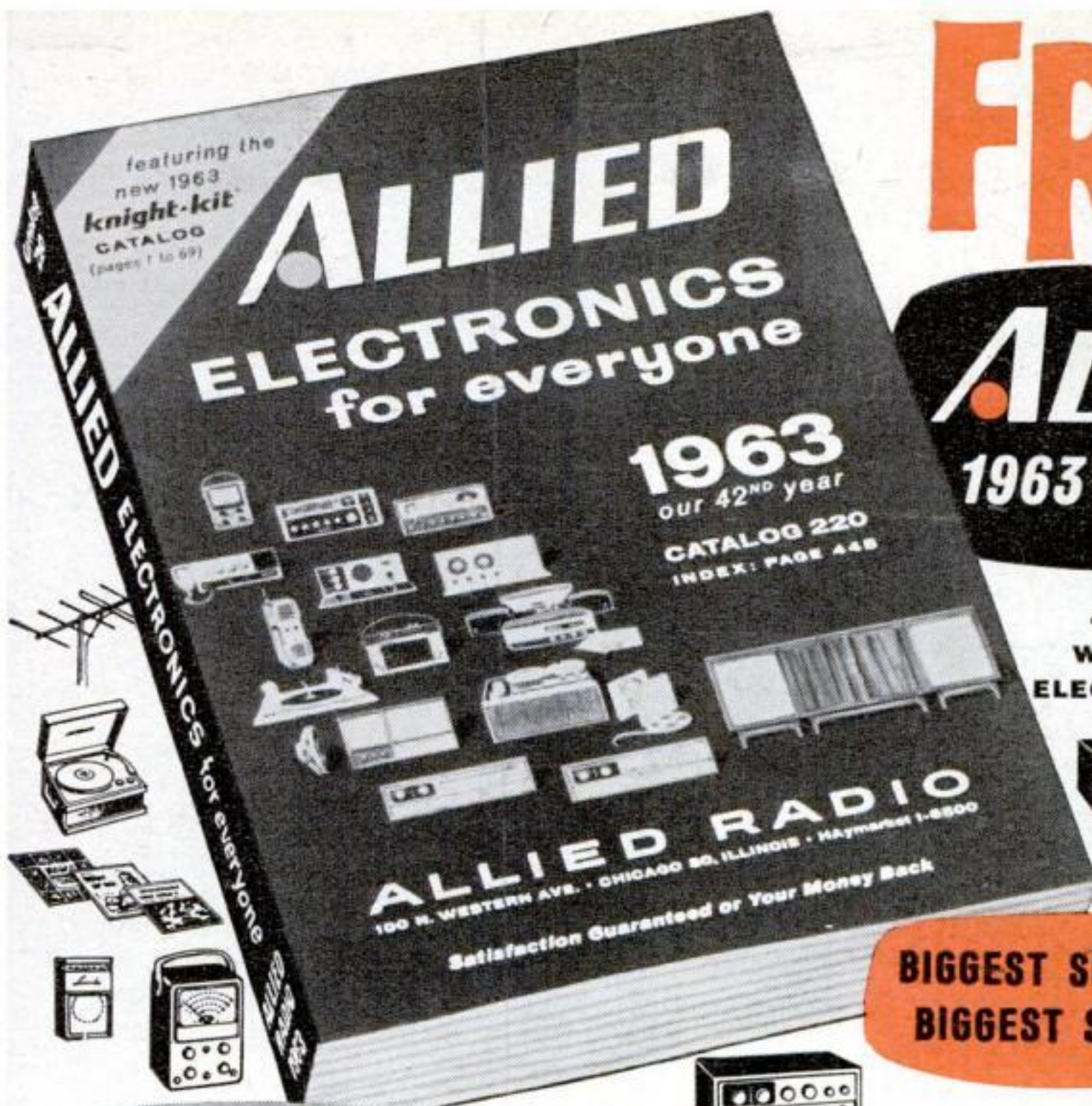
**Open-end mortgages.** Check your present mortgage to see if it contains an "open-end" clause. Under this provision, you can sometimes reborrow up to the full amount of your equity—the amount you've already paid off—and tack it onto the existing mortgage *at the same rate of interest*.

The new amount is accounted for either by increasing your monthly payments or by extending the repayment period. Such loans are hard to obtain, however, because banks are reluctant to lend money at the old rate—4 or 4½ percent—when they can now get 5¼ percent, or even higher, on a new mortgage.

**Mortgage refinancing.** This is mainly useful if you need a large amount that can't be obtained under any other loan plan. In this case, you arrange a new mortgage large enough to pay off the old one plus the new improvements.

The disadvantage: You pay the new, higher rate of interest. The advantage: You can often extend a new mortgage over a substantially longer repayment period than your old one—up to 30 years. At this rate, it's even possible that your new monthly payments, including the cost of improvements, will actually come out lower than your present payments.





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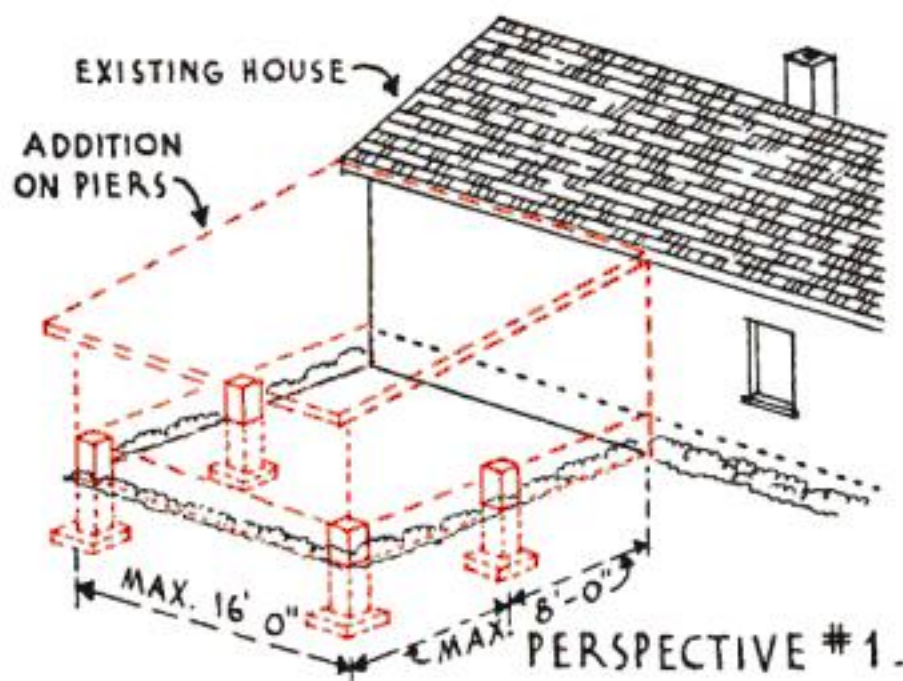
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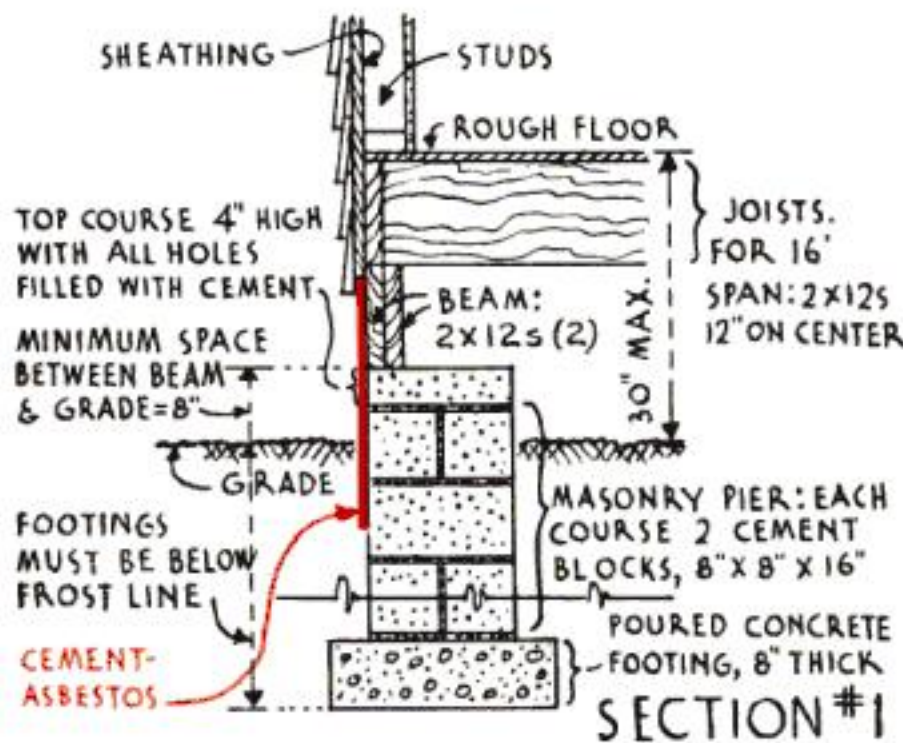




# Build on Piers and Save Money

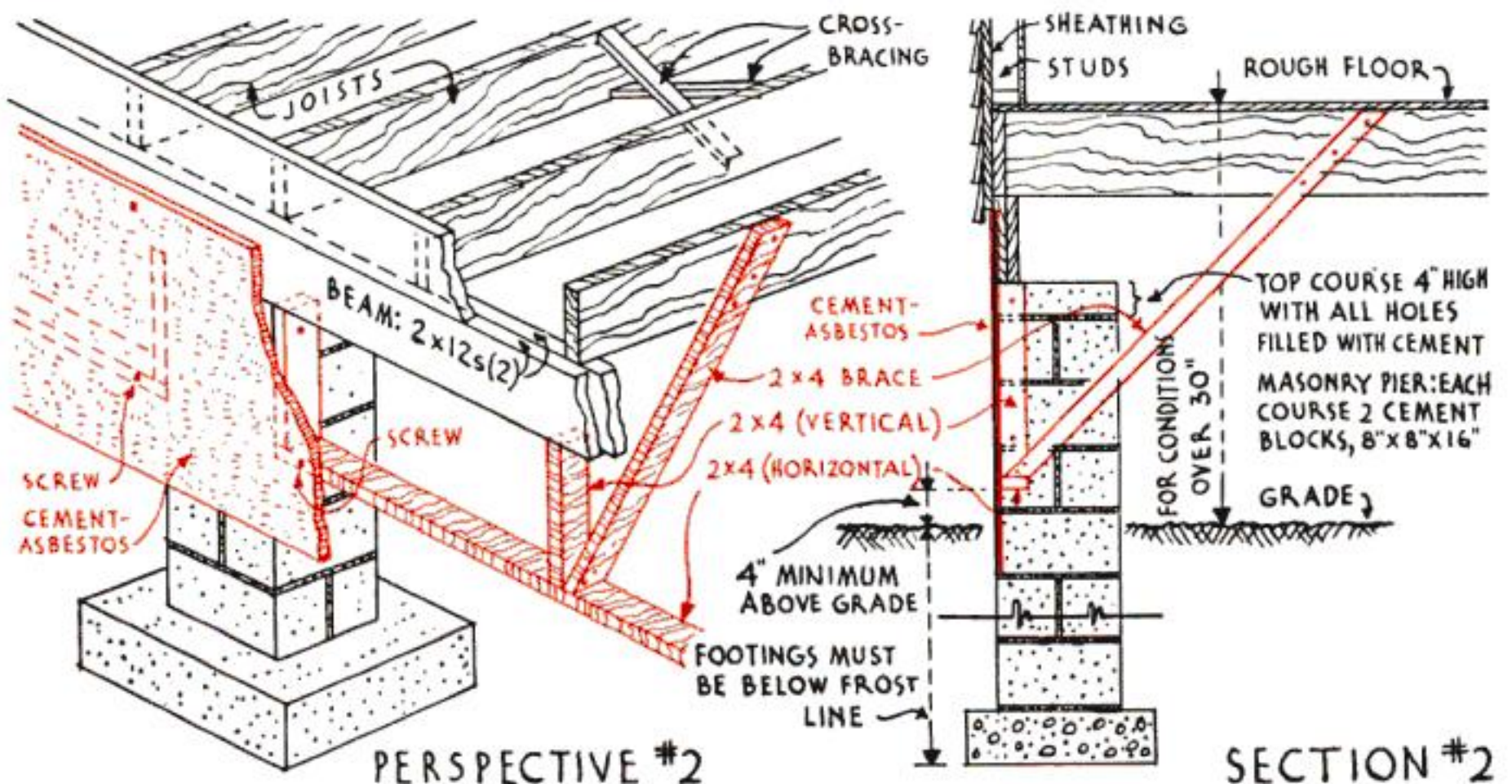
And if you enclose those gaping spaces above grade, you'll have a job that's handsome, too

**Y**OU can save money by building an addition on piers, instead of on continuous foundation walls. A 16'-by-16' room would need only four piers (Perspective 1). This means digging only four holes, with a minimum disturbance to your lawn and garden. Building on piers is standard in Southern states for low-cost houses, and for vacation houses almost everywhere.



The dotted lines of Perspective 1 (top) depict an addition on piers. Section 1 (center) shows the construction details applicable when the vertical distance from first floor to grade is 30" or less. A sheet of material impervious to rot and termites closes the space above grade.

Construction details, where height between first floor and grade is over 30", are shown below. Space between beams and grade is enclosed in much the same way as in Section 1, except that frame of two-by-fours is needed to support a wider sheet of the rot-resistant material.





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Why hasn't building on piers enjoyed nation-wide acceptance? Because those gaping open spaces between piers leave you with what is considered, usually, an unattractive appearance. You can, however, solve this problem so that it will be impossible to tell that the addition doesn't have continuous foundation walls. Appearance is only one reason for closing off the space between beams and grade—you also exclude wind, leaves, debris, and animals.

You'll want a sheet material that is impervious to rot (fungi) and termites, one that is locally available, and one that requires no upkeep such as painting. Available in practically every lumber yard is cement-asbestos in sheets (4' by 8' or longer), or in strips commonly used as siding. This excellent material is nominally  $\frac{3}{8}$ " thick, flat or corrugated, and obtainable in its natural gray or in a variety of colors.

**Footings.** The importance of sound footings for piers can't be overestimated. If a pier gradually settles or is once heaved by deep frost, even as little as  $\frac{1}{2}$ ", cracks will appear on the interior wall surfaces, windows and doors will not operate normally, and large fixed panes of glass may crack. For a margin of safety against a severe winter's frost penetration, be sure the footings (poured concrete, 8" thick) are below the lowest recorded frost line. In width, footings should exceed masonry piers at least 4" on each side.

**Piers.** Around the perimeter, piers can be up to 16' apart (see Perspective 1) in the same direction as the joists. In the other direction, a maximum of 8' is recommended. Corner piers are best made of standard 8"-by-8"-by-16" cement blocks, two per course, alternating direction every successive course. Intermediate piers could consist of a single block for each course.

**Beams and joists.** Lumber dimensions will depend upon the span between piers, and on what the floor will be expected to support. Filing cabinets, a piano, square dancing, and the like call for heavier members than normal use. Ask a responsible builder for his recommendations. If in doubt, err on the heavy side because the labor costs will remain the same, and joists and beams with a generous safety factor cost less than rectifying sagging floors.

**Cement-asbestos.** This material is brittle by nature, so it is advisable to drill holes where required near edges. Use screws rather than nails for installation, so that if

a piece must be replaced (accidental impact from a lawn mower or baseball), or if access is required to the crawl space, you will not have the problem of drawing nails and possibly cracking of the sheet. Locate the screws so they'll be easily accessible after exterior siding or shingles are on.

When any horizontal dimension of an addition exceeds the stock length of any cement-asbestos materials, make a close butt joint on a masonry pier or vertical wood member, and cover the joint with a strip about 2" wide sawed from the sheet material. Standard wood tools will do the job.

**Air circulation.** A limited amount of natural air circulation is needed in the crawl space, such as that provided by one stock 8"-by-16" grille on each side of an added room. One solution is to buy a few standard grilles, each with screening and a sliding shutter, and cut holes for them in the cement-asbestos sheet, where they'll be several inches above the grade when the sheet is installed. Screw the grille to the sheet before installation. Gain additional ventilation and convenient access by making an opening several feet wide, and at least 18" high, between the existing basement or crawl space and the new crawl space.

**Crawl space.** It's a good idea to have 24" vertical clearance between grade and the underside of joists, so you can crawl under, if it's ever necessary. There will probably be a difference of 5" or 6" between the grade level outside the addition and that under it (caused by scraping off the valuable top soil). This will help you secure the 24" clearance without lifting the addition too high above the ground.

**Vapor barrier.** After stripping the top soil and completing the piers, be sure that the entire surface under the addition is carefully raked and leveled. Then spread a sheet vapor barrier over this area to keep moisture from migrating upward from the earth. Plastic vapor-barrier material is nationally available, inexpensive, and tough.

**Insulation.** After joists are in place, but before the rough flooring is nailed down, insure a warm floor and reduced fuel bills by stapling 3" insulation batts between joists, or expanded aluminum foil of the type with three air spaces. Then staple a sheet of vapor-barrier plastic to the under edges of the joists to prevent any earth moisture that gets past the ground sheet from being absorbed by the insulation or by the exposed joists. ■ ■



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## "It Always Pays to Improve"

[Continued from page 150]

**Q** *How much should an addition cost?*

**A** This is guesstimating to some extent, but between \$12 and \$18 a square foot. That's finished, with heating, plumbing, and wiring. For a bare shell, you can figure on about \$7.50 to \$10 a square foot.

**Q** *What sort of features run the cost up higher than it needs to be?*

**A** There are oodles. If you insist on ceramic tile, fancy paneling, a hip roof, you're going to pay for them. If you want to save, take the contractor's basic job.

**Q** *Don't you save more on a shed roof than on a gable?*

**A** Believe it or not, no. A shed roof takes more materials and is thus more expensive—in fact, about 50 cents more per square foot. Except for a flat roof, the gable is the cheapest roof you can buy.

**Q** *What jobs can you do yourself and which are best left to a pro?*

**A** Let the pro do the basic framing and foundation work. The home owner can do the finishing—walls, floor tiles, insulation, and so forth. But one thing: Under no circumstances should a home owner ever attempt to do his own taping and patching of drywall. This is where a job can go sour. Leave this to a pro.

**Q** *Is it cheaper to have the whole job done at one time?*

**A** Definitely. It's hard to add plumbing, heating, and wiring after the basic construction is finished. Also, the contractor gives you a package price that's less than having the jobs done separately later.

**Q** *How can you protect yourself against shoddy workmanship?*

**A** Hire a contractor who has a good reputation in your neighborhood. Ask to see other jobs he's done. Find out if the owners are satisfied. Also, be sure your contract specifies exactly what you're getting—grade of lumber, spacing of studs, type of roofing. It should contain at least a year's guarantee on everything but concrete work. And don't jump at the lowest estimate—it may be too low for quality work. ■ ■



# Packaged Heat for Added Space

**W**HAT will you do for heat when you add an extra room? In modern development houses the most you can expect from existing equipment is the capacity to handle one extra room up to 10' by 15'. A heating contractor can advise you whether your furnace can carry even that additional load. If not, you'll need an auxiliary heating unit.

It's true you may have to spend a bit more to operate one of these, but the initial expense can be much less than for a major extension of your present system. You have a surprising variety of units to choose from—all compact and easy to install. They use gas, oil, or electricity.

Biggest boom is in gas wall heaters. A unit the size of an air conditioner can be hung on or recessed into any outside wall and vented directly through it. For heavier heating loads, there are tall, slender wall furnaces that recess between two studs and are vented up through the roof.

Electric heaters present an even wider range of types. Since no combustion is involved, no vents are required, and wall models may be recessed anywhere. For baseboard heat, you can buy strip units from 2½' to 10' long. There are overhead heaters you mount like a lighting fixture, and inch-thick radiant panels you bolt flat on the ceiling. Neither of these requires special wiring—you just hook them up to a wall switch or thermostat.

If you want to burn oil, your room heater will be the familiar kerosene stove. Such units are rarely built into the wall, and should be vented to an existing chimney.

Will you need only occasional heat? An all-metal, wood-burning fireplace may be the answer. Prefab units come complete, from ceramic-lined firebox to simulated-brick chimney. They're especially easy to install in new construction, and some models require no masonry or footings.

The floor furnace (burning gas or fuel oil) is another possibility, if your addition is built over a fair amount of crawl space. These range from one-register units you sink through the floor to full-size horizontal furnaces that hang from the floor joists.

**Skilled  
Machinists**

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South  
Bend**

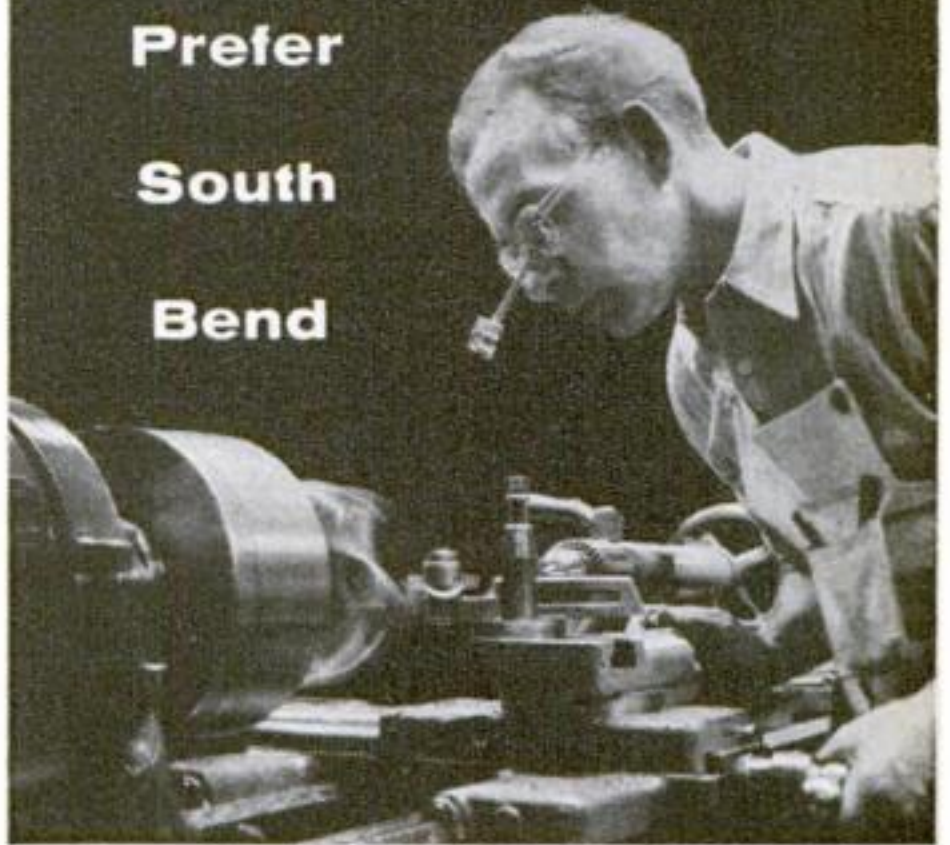


Photo from Learcal Division, Lear, Inc., Los Angeles

The day of the precise craftsman is not past. You should see how some of the nation's finest workmen go about doing their jobs with painstaking accuracy.

Such accuracy is absolutely vital in the manufacture of many of the precision components that make this "Space Age" possible.

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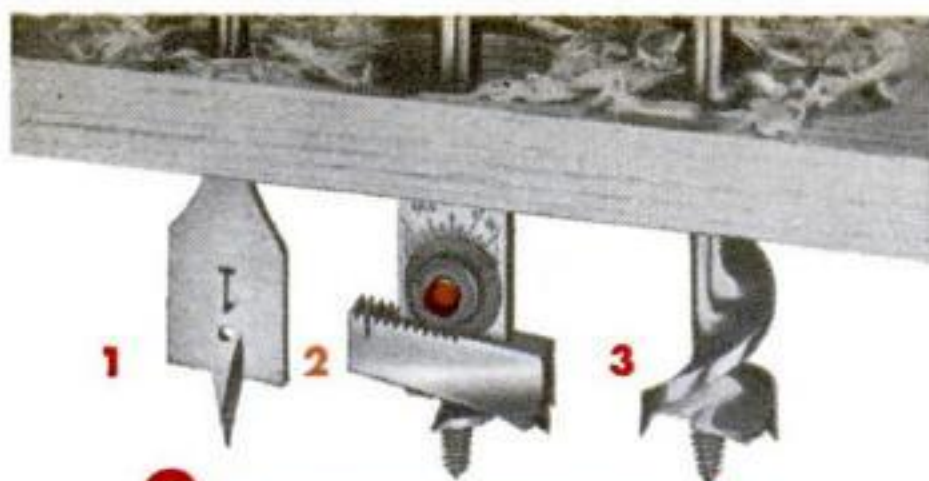


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**2. Irwin No. 22 Micro-Dial** expansive bit. Fits all hand braces. Just dial your size. Bores 35 standard holes,  $\frac{7}{8}$ " to 3". Only \$4.00. No. 21 small size bores 19 standard holes,  $\frac{5}{8}$ " to  $1\frac{3}{4}$ ". Only \$3.60.

**3. Irwin 62T Solid Center** hand brace type. Only 16 turns to bore 1" holes through 1" wood. Double-cutter boring action. Sizes  $\frac{1}{4}$ " to  $1\frac{1}{2}$ ". As low as \$1.05 each.

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## Expand Upward or Outward?

[Continued from page 152]

ceiling height, usually 7' or 7½'. Even if you were willing to settle for less headroom, you wouldn't be permitted to. That's why a dormer adds so much space. By increasing headroom, it makes more floor area available.

**Q** *Can't you finish just part of the attic to gain a small space?*

**A** Of course, but this becomes less economical. Even for one room, you need a stairway, you need a dormer, you need walls. It costs only a little more to extend the dormer and finish the whole attic. So I say again: The attic is your best bet if you need a lot of space, but it may not be if you need only a little.

**Q** *Suppose the roof pitch is too low to put on a dormer?*

**A** Then we raise the roof, giving you in effect a whole new second story. It's more expensive than a conventional dormer, but it practically doubles your house.

**Q** *But suppose you want a room that has to go on the ground floor?*

**A** You still have a choice. Don't forget—you can trade one space for another. If you now have bedrooms downstairs, you can move them into the attic and use the downstairs space for a playroom or expanded living room. Many floor plans will permit this, and often it's the cheapest way.

**Q** *Aside from cost, does an attractive addition do more for the overall value of a house than merely expanding the attic?*

**A** Not necessarily. In my opinion, the value is in the space, no matter where you put it. A big upstairs can mean a lot more to people than a dinky room stuck on the side. But ground-floor space saves you climbing stairs. To some people, this is very important.

**Q** *Doesn't your property and house style also affect your choice?*

**A** Of course. But here you are making a different kind of decision. If you



### Expand Upward or Outward?

have a house that looks too high and boxy, you'll do more for its appearance by adding an extension than by adding a dormer. A badly sloping lot can often be improved by the right kind of addition. Here, you're paying for appearance as well as space, and often it's worth it. However, if an extension will chop up your yard or create other problems, then you're better off going upward than out.

**Q** *Is it important to put an addition on the front or side where it will show?*

**A** Definitely not. The value is in the space, remember, not where you put it. A few people look for a big house, but most buyers will see the value in a house wherever it is. Often, with front and side-yard restrictions, the only place you can put an addition is in back of the house. This shouldn't stop you. Location is secondary to space.

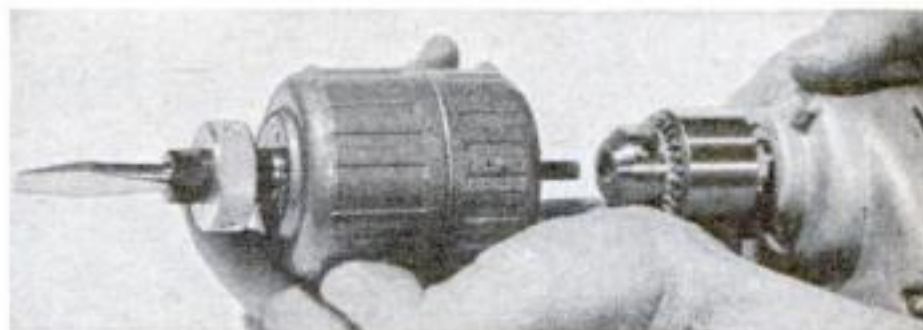
**Q** *What's the best type of foundation for an addition?*

**A** If the house has a basement, you'll need a built-up foundation under the addition to raise it to a matching level. But if the house is on a slab, it's simple to use a slab for the addition, too. However, an addition also gives you a wonderful opportunity to put in a small basement if the house doesn't have one. It costs more, but gives you space for storage and new utilities. I would also highly recommend the use of perimeter insulation around the outside of any extension foundation. This helps keep the inside warmer and saves you money on heating costs.

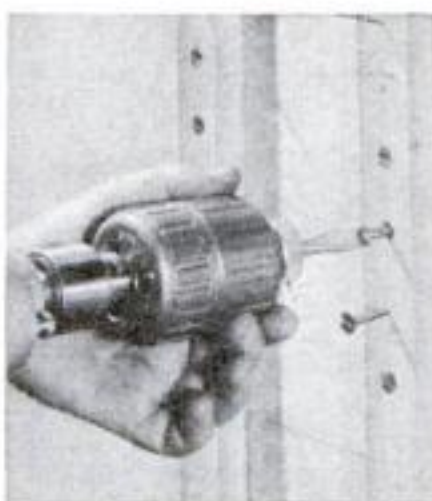
**Q** *What's the secret of making an addition look as if it belongs to the house?*

**A** It should follow the original architecture as much as possible. You don't stick an ultramodern wing on a homey little Colonial. Generally, it's best to make the outside finish match the rest of the house. And the new roof should harmonize with the original. It needn't be the same size or be turned the same way, but it's best to keep it in the same style. ■ ■

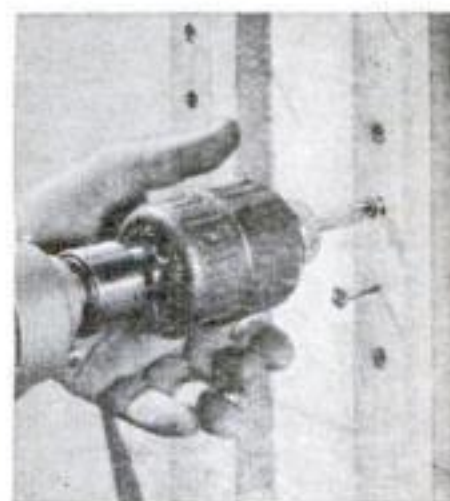
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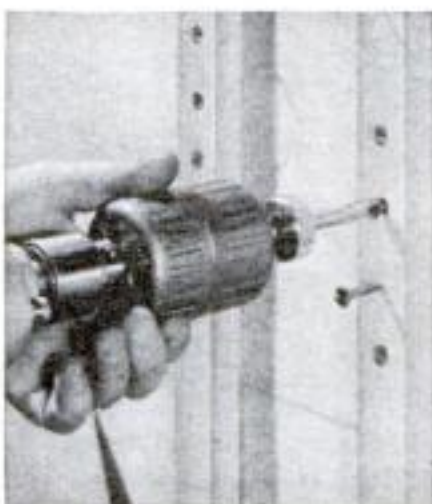


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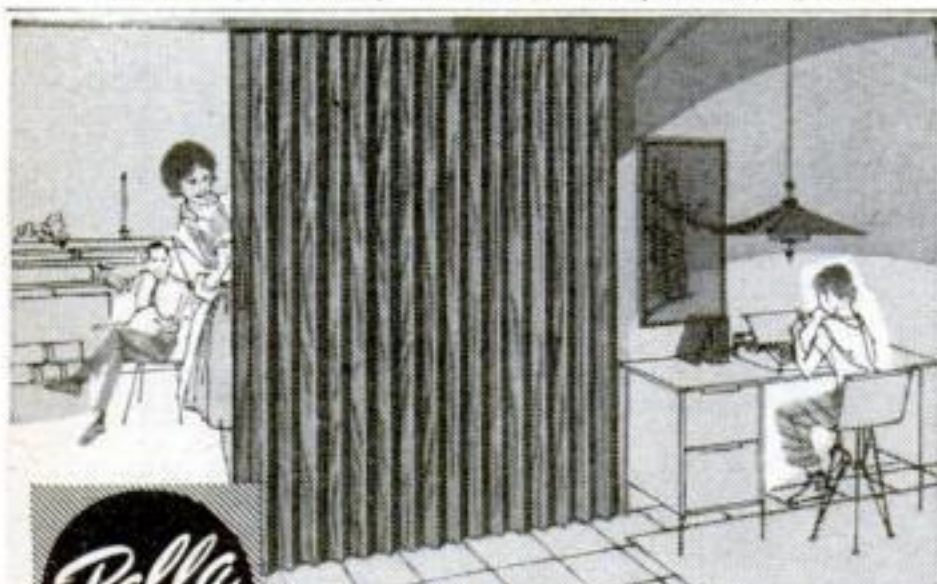
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# Booklets for Home Improvement

The following booklets are offered either free or at a small charge by the source listed with each. Please order direct—not from POPULAR SCIENCE.

**Manual on Finishing Plywood.** Simpson Timber Co., Dept. P, 2043 F Washington Bldg., Seattle 1, Wash. **Free**

**Carpentry and Building Construction** (TM5-460). Superintendent of Documents, U.S. Government Printing Office, Washington 25, D.C. **75c**

**Fashions in Fences.** West Coast Lumbermen's Assn., Room PSM, 1410 S.W. Morrison St., Portland 5, Ore. **Free**

**Plumbing.** The Small Homes Council-Building Research Council, University of Illinois, Urbana, Ill. **15c**

**Decorating and Shading with Colorful Canvas.** Canvas Awning Institute, Inc., P.O. Box 9907-PS, Memphis 12, Tenn. **25c**

**Suggestions for Proper Handling and Installing Factory-Finished Paneling.** Georgia-Pacific Corp., Dept. P, Equitable Bldg., Portland 4, Ore. Attn: Carol Olson. **10c**

**18 Fascinating Remodeling Ideas for Your Home.** Weyerhaeuser Co., Dept. P, Wood Products Div., Tacoma Bldg., Tacoma 1, Wash. **25c**

**Weldwood Prefinished Paneling for Fine Interiors.** U.S. Plywood, Dept. P, 55 W. 44 St., NYC. Attn: Nancy Stuart. **10c**

**Fir Plywood Construction Guide.** Douglas Fir Plywood Assn., Dept. P, Tacoma 2, Wash. **10c**

**15 Spare-Time Projects with Sakrete Concrete and Mortar Mixes.** Sakrete, Inc. Dept. P, Cincinnati 17, Ohio. **Free**

**Proper Nailing Practices.** Western Pine Assn., Dept. P, 510 Yeon Bldg., Portland 4, Ore. **Free**



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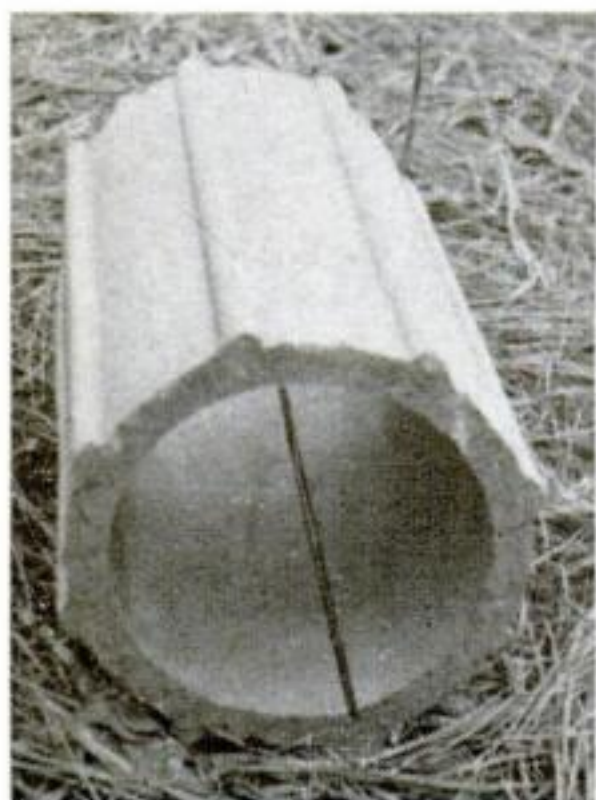
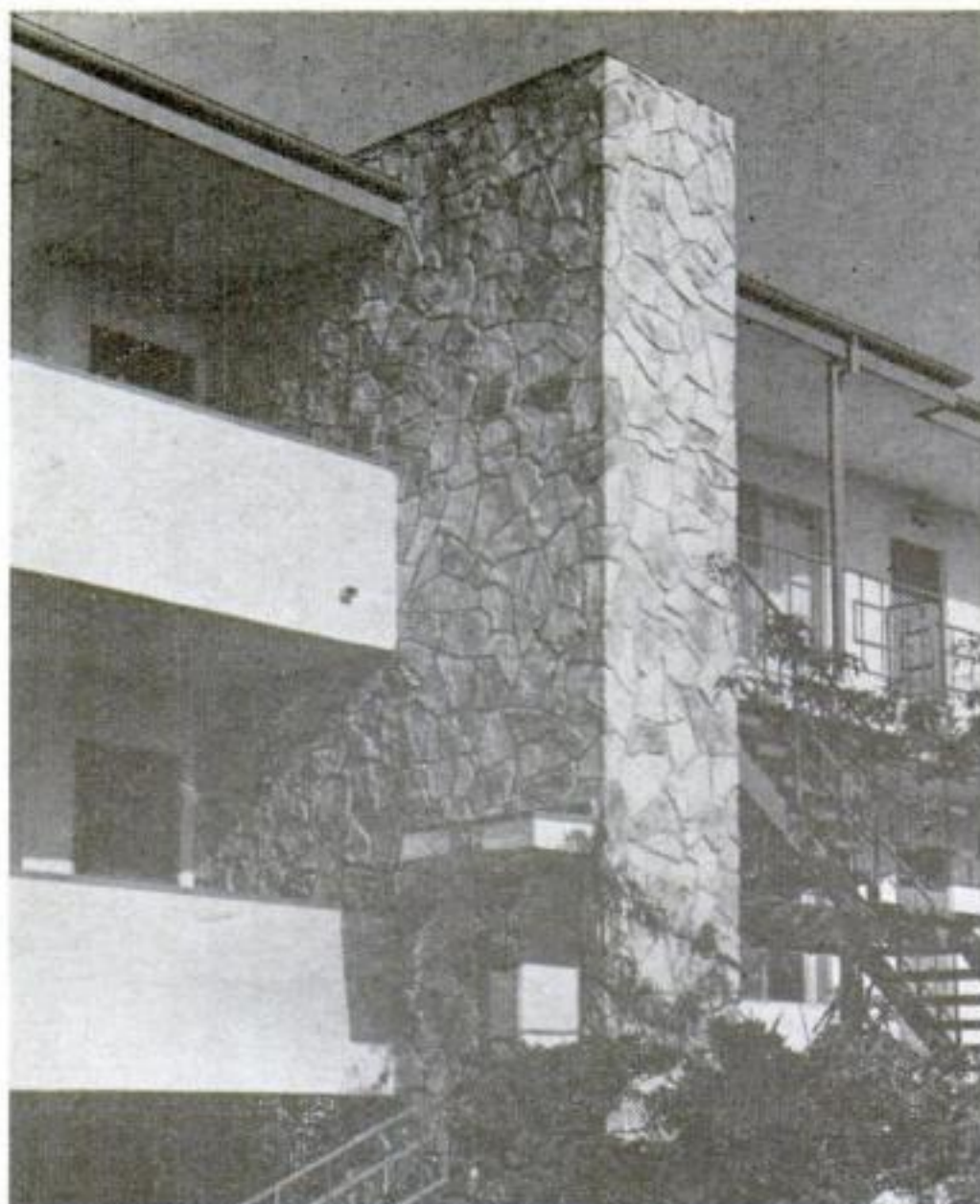
## Two New Ways to Build Masonry Walls

**F**IBER-GLASS panels and clip-on bricks can cut out most of the work of putting up a masonry wall.

The panels (top photo), in brick or stone finish, have the color, texture, and feel of masonry. You cut them to size with a saw, nail them in place without mortar. Cost from Deko Products, 59 Gillett St., Hartford, Conn., about \$32 a panel.

You mount the clip-on bricks individually on nailed steel hangers. Mortar is applied with a pressure tool included (on loan) in the price—under \$1 a square foot. The bricks—15½" long, 2¼" wide, and 1" thick—are baked with a pumice instead of clay base. Meridian Brick Co., 234 Herricks Rd., Mineola, N.Y.

▶▶▶ New in rubber stair treads—oak grain. Noses and risers, 89 cents to \$2.49. Crown Rubber, Fremont, O.



### Copper wire in drain tile resists root growth

Roots growing in the uncemented joints of drain tiles will in time cause stoppage. Now ceramic tiles are available that are said to prevent this. They are constructed on a 25-year-old principle: Absorption of copper salts breaks the roots down. Crumpler Brick and Tile Co., Roseboro, N.C., combines the copper with the ceramic by putting a length of copper wire in an inside groove. It will ship the tile at 35 cents per foot to within 400 miles, to greater distances for slightly more.

▶▶▶ Triangular molding of flexible porcelain-white vinyl seals joints between walls and bathtub, shower, sink, or counter top. Cemented in, it won't pull out or crumble, cleans with a damp cloth. A kit containing 15' and sufficient cement, \$1.69. Crest Co., 26 Ave. B, Newark, N. J.



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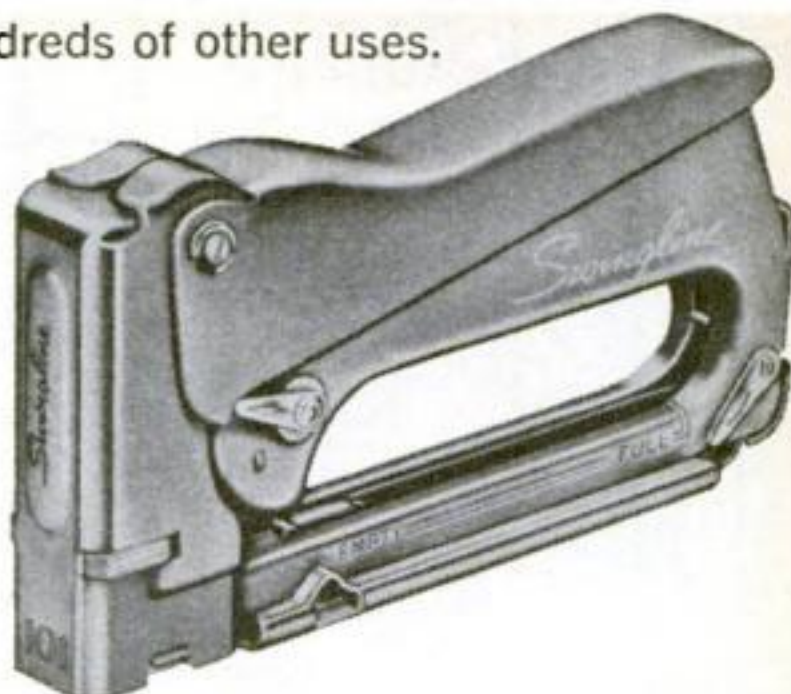
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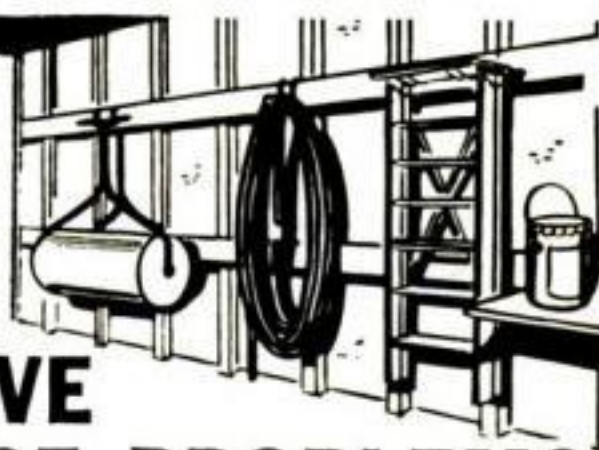
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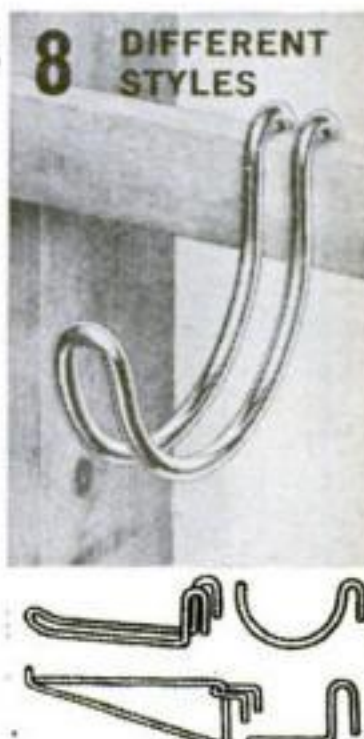
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panels can be shifted if they don't go on straight. Rotproof, they provide insulation, with vapor control in damp climates.

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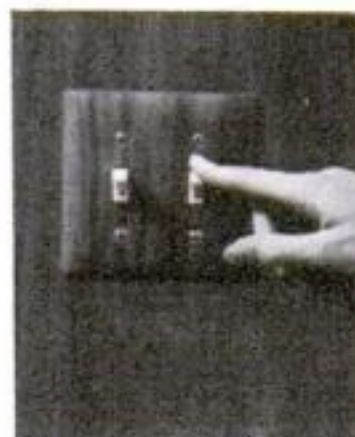


## How to tint clear glass on a patio

Now you can tint the glass on an enclosed patio or sun porch. A transparent alkyd-base liquid plastic has been developed by Du Pont and Sun-X International, Inc., of Houston, Tex. It's flowed on the pane through a pump applicator, dries in 30 to 40 minutes, won't scratch, peel, or chip. Equipment is costly, but you can have a Sun-X franchised dealer do the job for around \$1 to \$1.35 per sq. ft. of glass.

## Wooden switch plate for paneled wall

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**FIRST STAGE: A PATIO**

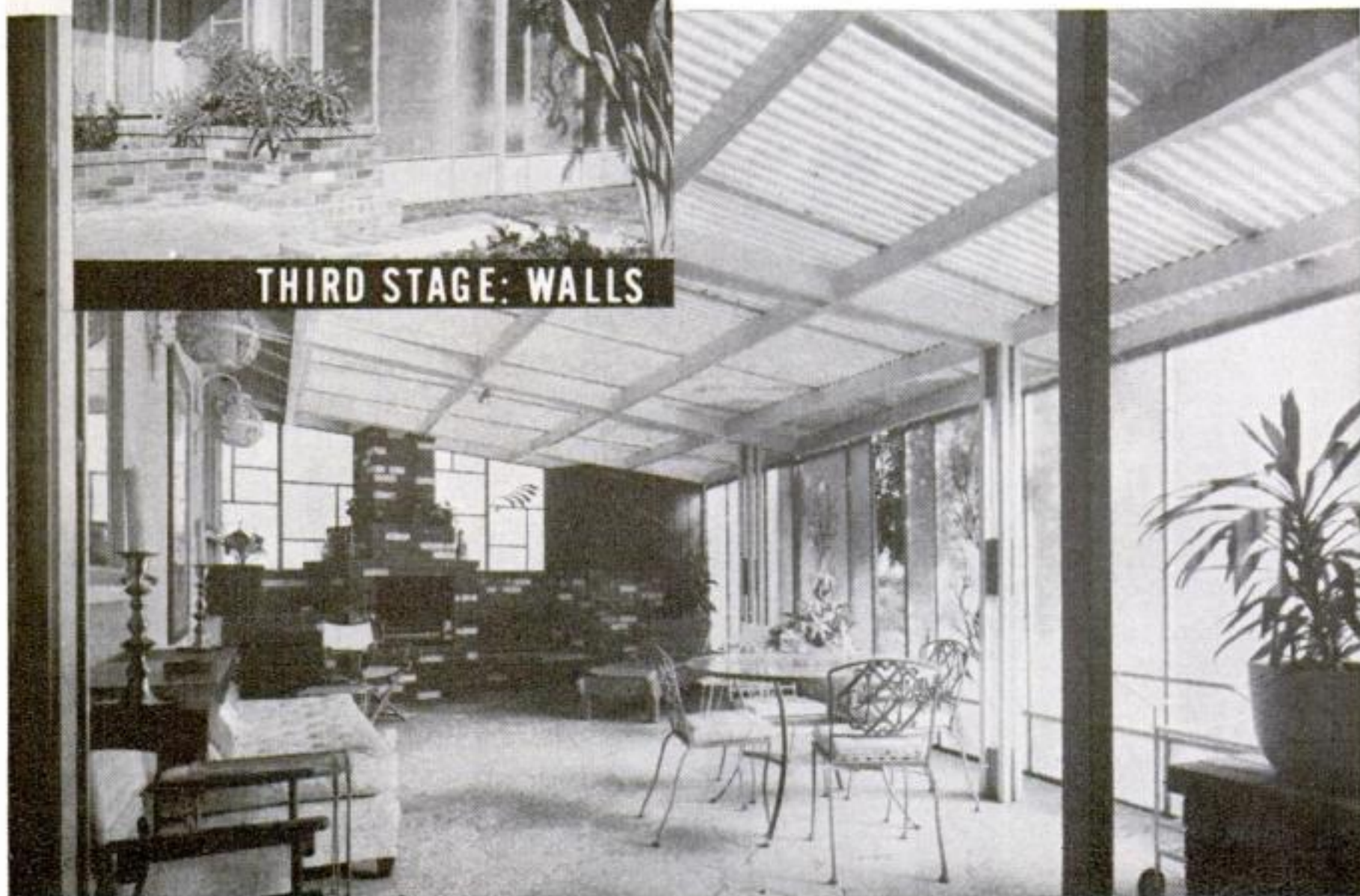


**SECOND STAGE: A ROOF**

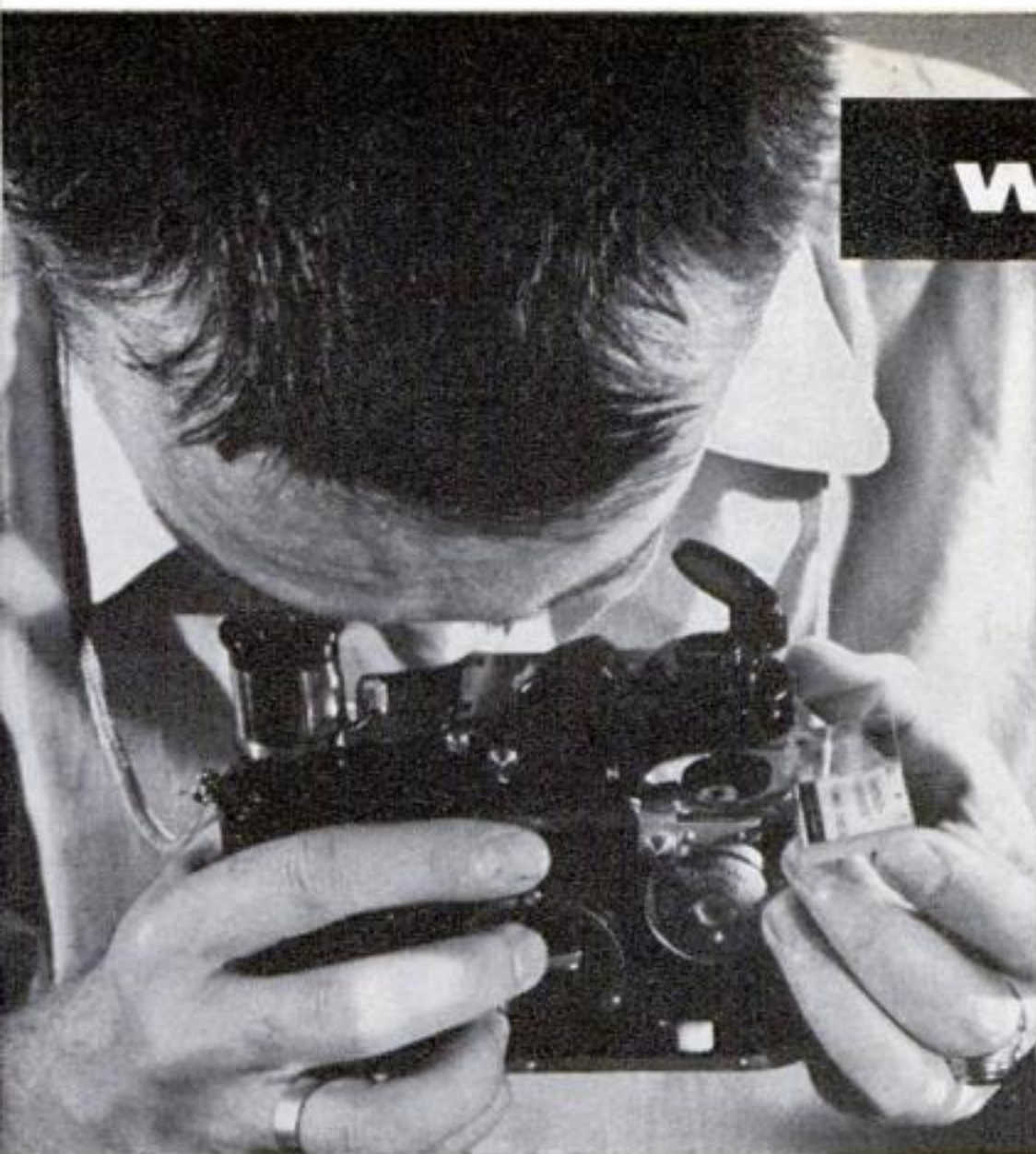


**THIRD STAGE: WALLS**

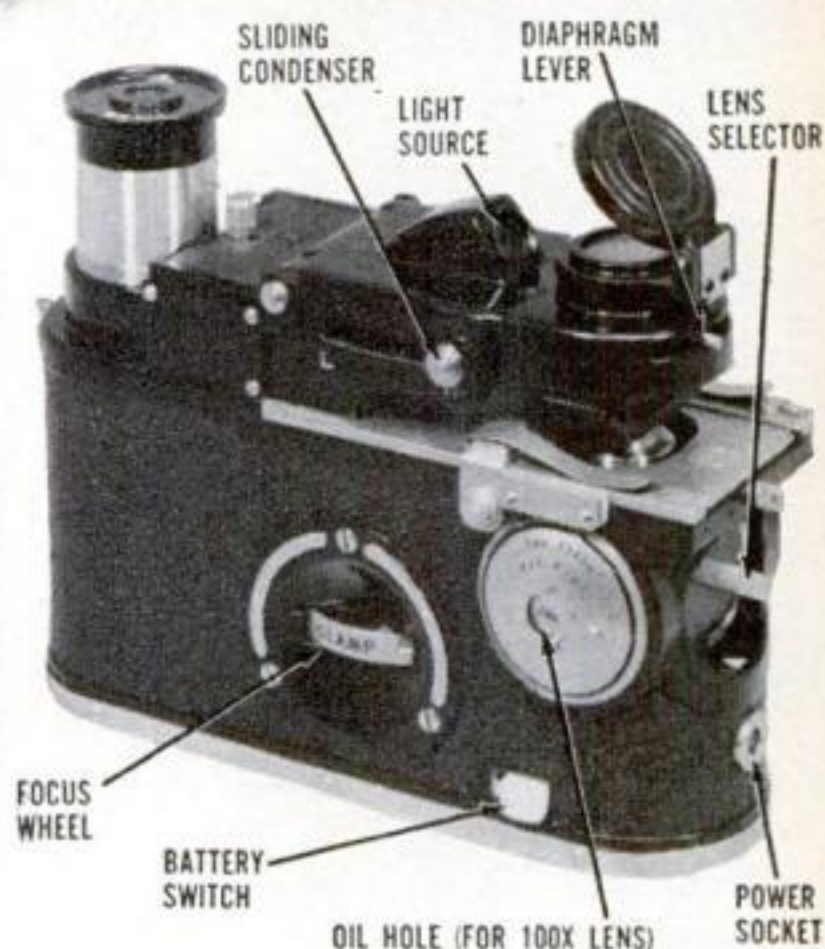
**P**ROGRESSIVE building is the way to spread the cost of a new room over several years and still get good use from it as you go along. In this California home, a concrete slab was put down first to provide a terrace. Later, this was roofed over with translucent panels of corrugated fiber-glass, supported on a light wood framework and columns. The final stage—a wall of sliding glass sections—completed the enclosure, creating the sunny, spacious room you see below. In colder climates, full frame walls or double insulating glass would be substituted for maximum warmth.







## what's new



### Midget Microscope Goes Where It's Needed

**I**T LOOKS and handles like a 35mm camera, features a lens turret, and comes from the Japanese makers of the Nikon—but the neat handful above is a field microscope. It can be carried to a lake shore to test the water for purity, or used by a doctor to do an on-the-spot blood test. And anyone can tramp the woods with it looking for hobby specimens.

Clip a slide on its movable stage, spin a dial to select desired magnification (it

comes with 4X, 10X, 40X, and oil-immersion 100X objectives), and choose from three types of illumination: In daylight, pivot the mirror to focus a beam downward; in dim light, switch to a built-in lamp powered by two penlight batteries; indoors, use regular house current by plugging in a 3½-volt transformer. All light levels can be controlled by adjusting an iris diaphragm. It's the Model H from Nikon, Inc., 111 Fifth Ave., NYC, and costs \$385.

### You can measure rainfall without getting wet

With this gauge you needn't go out into the storm to get an accurate measure of rainfall. It consists of two Tenite plastic vials connected by tubing. One—the catch basin—is installed above the roof peak, away from interference by trees. The other is calibrated for mounting outside a window. Made by Pride Products, P. O. Box 4505, Austin, Tex., it costs \$1.99 with clamps to fasten the tubing to the side of the house.





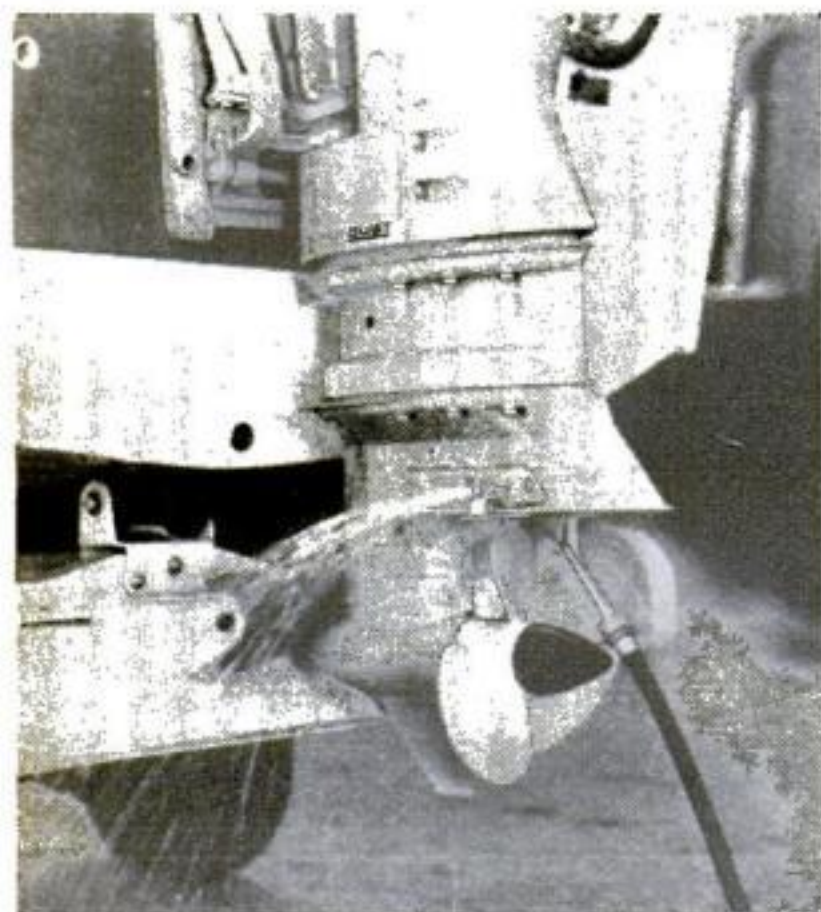
## what's new

### .....BOATING



#### For sportsmen: fun in a tub

A molded fiber-glass body encased in a tractor inner tube, the Tadpole suits all ages. A hand-powered flipper or an electric trolling motor keeps it going. With flipper, it's \$165; with motor, \$295. Eton, Box 1471, Memphis.



#### Garden-hose hookup tests motors

Attach it to the water intake of an outboard, and the Testit-Flushette lets you make minor repairs on the motor at home. You just turn on the water and run the motor in neutral at 500-1,200 r.p.m. Most engines are flushed in five minutes. All models, \$4.95. Tempo Products Co., 2062 E. 70th St., Cleveland.



Converging perspective



#### Sound converter for silent projector

The synchronizer at left is used with a Concord tape recorder for movie synchronization. Sound may be recorded during filming or dubbed in later. Audio-Sync may be used with any projector. \$30. Concord Electronics, 809 N. Cahuenga Blvd., Los Angeles.





is easily corrected, as above, with Nikkor lens

## what's new ..PHOTOGRAPHY



### 35mm Lens Controls Distortion

**C**ONTROLLED perspective, once limited to cameras with rising and shifting fronts, is now possible with the 35mm Nikkor  $f/3.5$  lens.

Turning a thumbscrew offsets the lens up to 11mm. Rotating the offset lens (up to 360 degrees, with 12 click stops) then puts it at any point around its mount—up, down, or to sides. In Nikon F mount with preset diaphragm, \$249.50. Nikon, Inc., 111 Fifth Ave., NYC.

#### Rapid slide changer for table-top viewer

A flick of the lever on this viewer (right) changes slides. Tray holds up to 25 slides for semi-automatic operation. Compact in size, the Ikoscop slide viewer is used either for rapid scanning or leisurely previewing. Uncut films are viewed with special holder. Price, \$14.70. Carl Zeiss, Inc., 444 Fifth Ave., NYC.

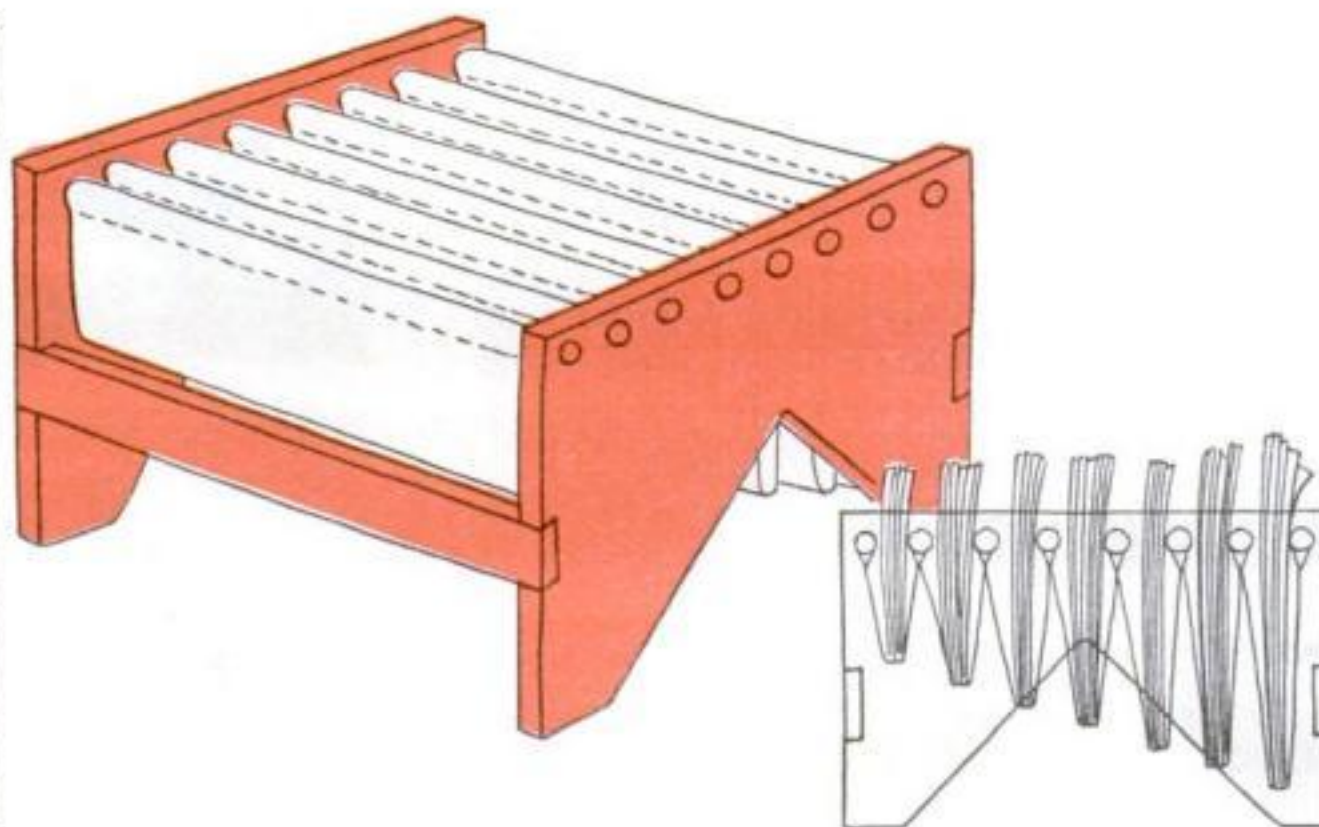
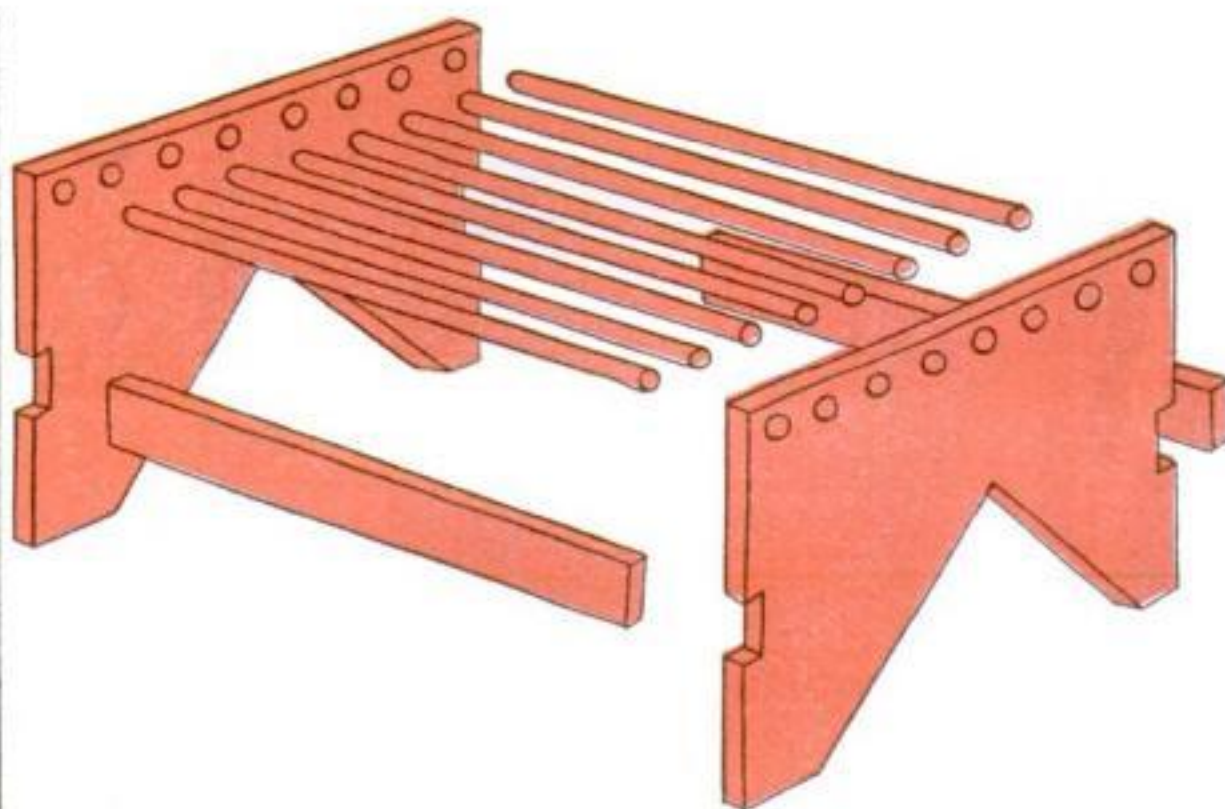
▶▶▶ High speed Ektachrome film is going to market in 120 roll film. Made in both daylight and type B emulsions, it has the same speed characteristics as 35mm.



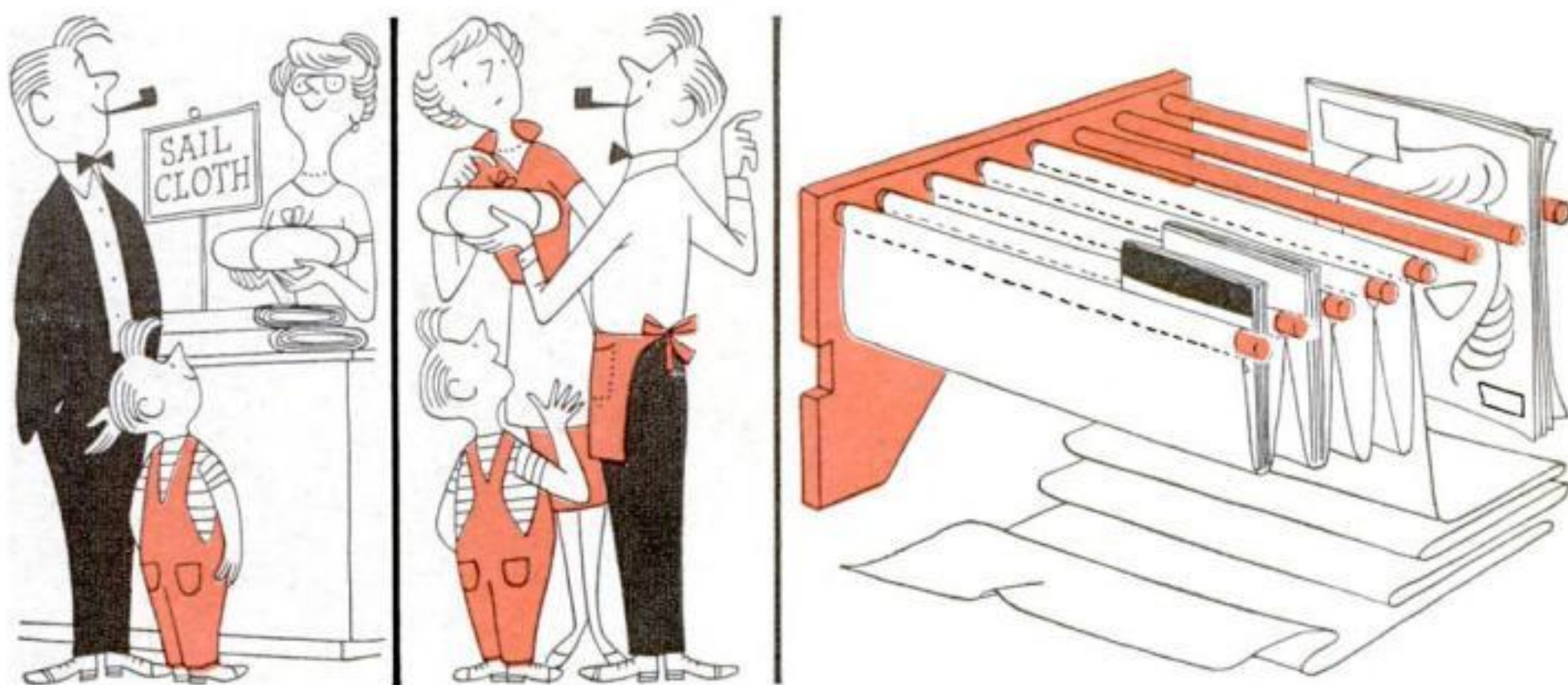


# Wordless Workshop

By Roy Doty







## Got an idea for Wordless Workshop?

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## The Incredible Ruby Ray

[Continued from page 92]

tered the field. Today you can even buy do-it-yourself laser kits complete with instructions. Edgerton, Germeshausen, and Grier, a Boston firm, sells flash tubes and power supplies for lasers. Get a ruby rod from the Linde Company of New York and you're in business. (One warning for amateur laser-builders: The extremely powerful light beam can injure your eyes.)

The first (and still most common) lasers use rubies—crystals of aluminum oxide containing a trace of chromium. The chromium atoms give rubies their red color, and also generate the red-colored laser ray. A mixture of helium and neon gases and special types of glass have also been made into lasers. The color of the laser ray depends on the material used and on the way its atoms are "pumped" into an excited state.

**Light work.** The race now is to put the laser to work at useful jobs. It can help space ships rendezvous in space. The problem here is to measure accurately the rate at which the two ships come together. From speeds of thousands of miles an hour, they'll have to slow down until they meet gently.

A few weeks ago a Sperry Rand engineer showed me a laser speedometer, a light-wave Doppler radar. The Doppler effect is what makes the whistle of a train coming toward you seem higher in pitch than it actually is—the train is a little nearer as each cycle of the whistle's sound wave begins, so the waves squeeze together and sound higher.

A radar—or light—wave bounced off an approaching object works the same way: It seems higher than it is. In the laser speedometer, the coherent light is split into two beams. One is routed into a photomultiplier tube—a gadget that detects light pulses. The other beam goes out to the target, bounces back, and also hits the photomultiplier.

As the target moves closer, the returning echo, because of the Doppler effect, becomes higher. Now the two signals reaching the photomultiplier are at dif-

ferent frequencies. The faster the target approaches, the greater the difference. A special circuit computes from this the speed of the approaching target.

The sensitivity of this speedometer is astonishing. The target on the model I saw at Sperry was a small steel plate bolted to a lathe tool mount. By turning the feed knob, you could move the target back and forth slowly. When the target moved forward, even at a fraction of an inch per second, the change in frequency was clearly visible on the scope.

**Aladdin's lamp.** The laser may turn out to be the first practical undersea communications device. Radio waves are useless under water, since they are absorbed so rapidly. Light may do better. Researchers are now working on a laser that produces green light—the color least absorbed by water.

The laser may finally realize an old dream: transmission of power without wires. With the higher-powered lasers now being developed, Dr. Townes recently calculated that 10,000 watts of energy might be transmitted to a spot six inches across and 1,000 miles up. That's more than enough to operate a space ship—even propel it in space—though not enough to accelerate it from the ground into orbit. One problem: The atmosphere absorbs much of the power. But it might work from a mountain top.

More powerful lasers might send out so much energy that they could actually push around in orbit large, light satellites like the Echo I. If the satellite starts to drift, hit it with a laser beam and nudge it back into position.

And most exciting of all, Dr. Townes recommends that we use these super light-makers to get in touch with intelligent races on other planets. Their fantastic power would make them our best bet for signaling over intergalactic distances. Townes suggests that perhaps we should take a careful look around the sky for laser flashes right now. Maybe somebody out there is already flashing our way. ■ ■



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## What Makes the Moon Look So Big?

[Continued from page 76]

sion" with an artificial-moon projector of their own devising. The novel experiments were made by Dr. Lloyd Kaufman of the Sperry Gyroscope Company and Dr. Irvin Rock of Yeshiva University.

It was definitely a riddle for psychologists—for only the human eye sees the moon enlarged near the horizon. Low or high, it looks the same to a camera, photos show. That rules out a physical explanation, like refraction or light-bending by the earth's atmosphere (which couldn't be the reason, anyhow, since it would tend to shrink the "horizon moon" instead of magnifying it).

Until the 1940s the favored explanation of the illusion was one advanced in the second century by the Egyptian astronomer Ptolemy: The low moon looks oversize because objects on the horizon—such as buildings, trees, and hills, which you know to be much less distant than the moon—serve as a gauge to emphasize its comparative bigness.

*It sounded simple and logical*—until a Harvard astronomer, Dr. Fred L. Whipple, pointed out what seemed a fatal flaw: Why, then, do you also see the moon illusion over the ocean, where trees and houses are nonexistent?

Harvard psychologists meanwhile had come up with a new theory: Raising your eyes to the "zenith moon" diminishes its apparent size. Why, they couldn't say. But in trials, they reported, the zenith moon looked as big as the low one when observers raised their heads instead of their eyes, or lay on their backs, to view it.

Proving who was right hung upon accurate measurements—and how to measure an intangible illusion posed a nice question. The Harvard observers had attempted it by comparing the real moon with disks of light thrown on a screen less than 12 feet away. Doubting that such unlike things could be matched reliably, Drs. Kaufman and Rock designed a more refined gauge—their artificial-moon projector.

Peering into an oblique glass or mirror, an observer saw a luminous disk—looking as distant as the real moon—projected above the landscape by a lamp bulb and lens. By turning a control knob, to rotate a drum with graduated holes between bulb and lens, he could vary the "moon's" apparent size.

The experimenters set up two of the projectors, side by side. One threw a "moon" on the sky near the horizon; the other, near the zenith. Turning from one projector to the other, an observer could bring the "moons" to matching size by twirling either control knob. Then the settings of the knobs measured the actual relative size of the projected disks—and thus the precise magnitude of the moon illusion.

*Looking into the projectors*, 10 obliging Freeport, N. Y., neighbors gazed at the zenith "moon" with heads raised—making sure of it by grasping an inclined "biting board" with their teeth. They also looked with heads level and eyes raised. Which they did made no difference, the settings of the knobs showed. Each way—taking averages—the horizon "moon" looked  $1\frac{1}{2}$  times as big as the zenith "moon" in diameter, or of more than twice its area. This measured the moon illusion precisely for the first time—and flatly contradicted the earlier findings at Harvard.

From 7 to 55 college boys and girls were subjects in a dozen more experiments at outdoor Long Island, N. Y., sites, on a New York City roof top, and in a city planetarium. These tests completed demolishing the "eyes-raised" theory of the illusion. Ruled out, too, were ideas it might be caused by differences in brightness with the moon's height, or by the harvest moon's red hue.

Was it back to Ptolemy, then? Yes, more trials proved. One of several clinchers: When a cardboard mask hid the terrain, the horizon moon looked no bigger than the other—no illusion.

But that "ocean" objection? Easily disposed of, concluded Drs. Kaufman



### What Makes the Moon Look So Big?

and Rock. It had been dragging in needless props, to suppose that the scenery must include trees or any other familiar objects. Actually, experience has trained your eye in the same principles of converging-line perspective that artists apply—so it's quite capable of judging the extent of a blank patch of distant ocean or desert. And that's all that it takes to elicit the moon illusion.

The new trials add these tidbits: Some people see the horizon moon magnified

much more highly than others do. (To a very few, who may have been puzzled by reading about what others see, it hardly looks magnified at all.) The illusion varies in degree with the scene—the more distant the visible horizon, the more striking it becomes. It's also enhanced if the setting moon happens to be framed between buildings.

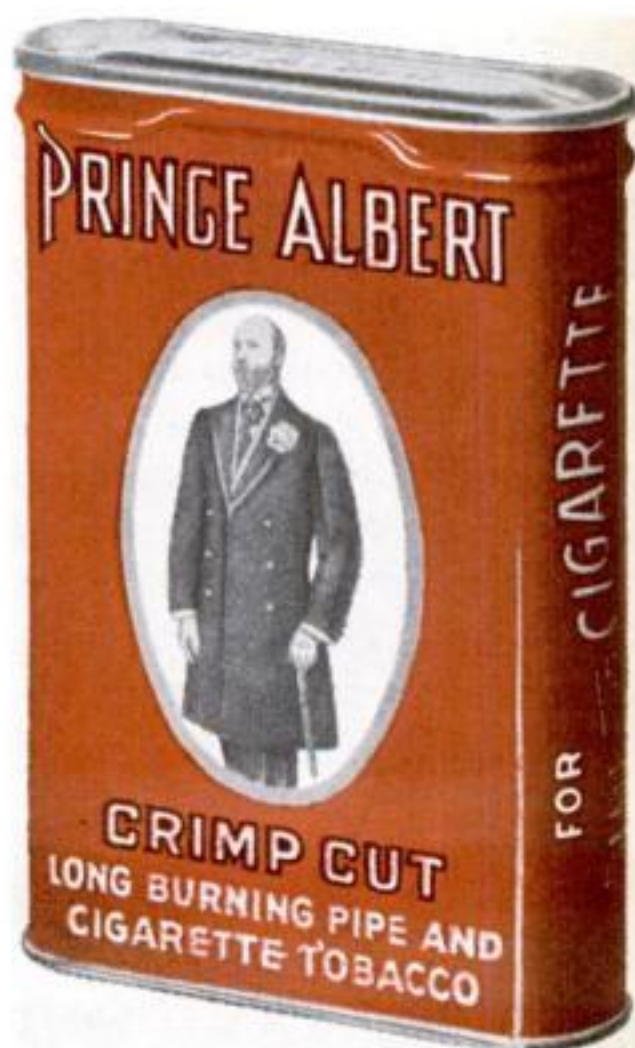
All these findings fit the illusion's now-proven explanation. And so ends the mystery of the magical moon. ■ ■

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maximize the amount of solar radiation it gets by day, and be adapted to store it at night. Think of a perfect black-body kind of plant that shrivels or curls up tightly into itself at night.

"The leaves of the plant should be thin and broad-surfaced enough to absorb the most heat (like a tobacco leaf), and at the same time have the flexibility to withstand the winds (like fern).

"A more drastic solution would be plants that could simply freeze up overnight and thaw out in the morning. It's not impossible. Over at the greenhouses I can show you some alpine plants that do just that."

"What about the water requirement?"

"That's harder. When the Martian polar caps melt we can't seriously suppose there's a flow of liquid water toward the equator."

"But maybe Martian plants don't use water the same way," I suggested.

"That's a possibility. Water may act like a vitamin to them. In which case they wouldn't need as much.

"Still, that doesn't solve the problem of storage," he added. "Earth plants wilt if they lose too much water. So what could Mars' plants do?" Salisbury asked himself, moving the chair around so he could lean on the desk and cradle his head in his hand. "Well, there's a way out here, too," he answered his own question. "Surface coatings. We know some compounds can be spread very, very thinly on water to prevent the water from evaporating and yet let gases through. An Israeli scientist has been experimenting along these lines to prevent losses from plants."

"Hmmm. Life isn't getting any easier. So far we've got these black-bodied plants with surface coatings that maybe freeze up at night. What about oxygen?"

**The oxygen problem.** "Yes. That's the most serious problem the 'life' theories have to face. If any kind of photosynthesis goes on, a plant sooner or later has to exhale oxygen. Where is it?"

"It could be tied up in the iron oxides

on the deserts or under the topsoil, of course. Maybe these Martian plants are clever enough to break iron oxides down the way Earth plants do water."

"Maybe they don't need oxygen?" I suggested.

"Well, that's a neat way out, too. They might breathe nitrogen instead. As I said before, we should be prepared for some surprises as to what we find."

"Yes, let's get back to those still higher forms you talked about."

"First there's this business of the satellites . . . There are the canals, too."

"You really believe they exist?"

"I do. I know some people say they're just isolated points that the eye connects up. Yet independent observers . . ."

"You sound like a TV commercial."

"See for yourself." Salisbury led me to his lab next door. He pulled out a lantern slide and set it under a microscope. Next to it he put a drawing.

"Here are two views, made at different times by different people."

**Those Martian canals.** With one eye cocked into the microscope and the other looking at the drawing, I had to admit that the patterns were remarkably similar. Especially in the "star clusters."

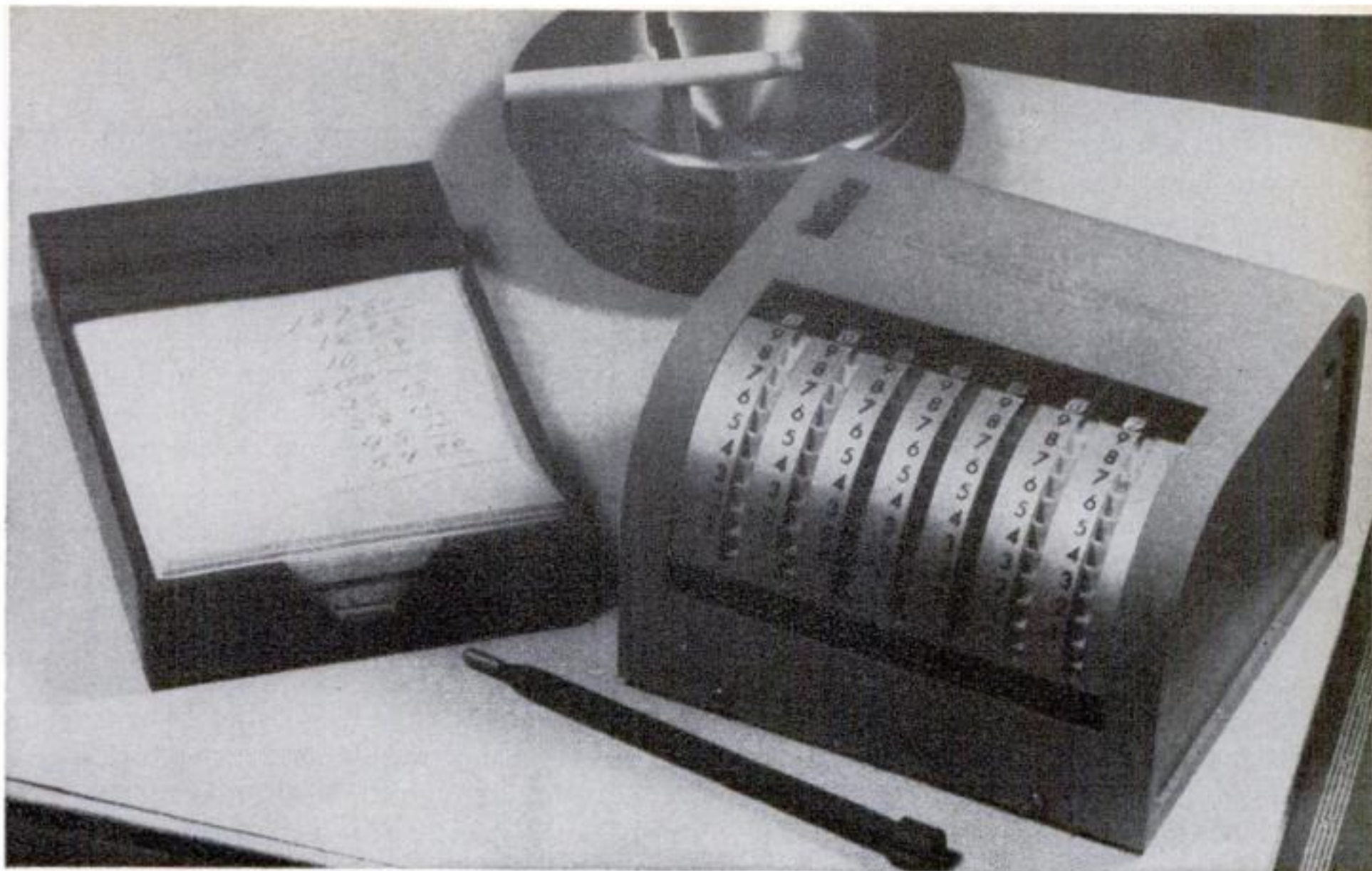
Salisbury nodded with satisfaction. "To me, the fascinating thing is that the patterns are so regular. At instants of good 'seeing' you spot a closed grid of lines that extends over the whole surface, never dead-ending in the deserts.

"No one really thinks they're super-highways or intersecting Suezes and Panamas. But some respectable scientists do think they could be underground waterways that feed surface farms.

"Which is another good reason why I think it's better that we make the trip to Mars ourselves rather than send robots. Imagine how you'd feel—an intelligent nitrogen breather or whatever you are—if some fuming, monstrous, metal blob plopped down in your back yard."

"Don't look now," I whispered to Dr. Salisbury, "but there's a Mysterious Creeper moving up behind you." ■ ■





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## Have They Found the Pharos Lighthouse?

[Continued from page 110]

like Fort Kait Bey, whose outer wall occupies largely the same position.

The Pharos, towering at least 500 feet above the sea, was the world's tallest building in its best days, 279 B.C. to 700 A.D. It was built by the Greek architect Sostratus for the second Ptolemy of Egypt. At that time, most Mediterranean traffic plied between Greece and Egypt, and it was essential that there be some beacon to guide mariners past the shoals at the entrance to Alexandria's harbor.

**Sostratus outdid himself.** The great lighthouse he built had four main sections. The bottom story was 100 feet square, 200 feet high, and reportedly contained 300 rooms.

"Why so many?" I asked Dr. Riad. "Was it a fort as well as a lighthouse?"

"It may have been," he replied. "Julius Caesar had to seize control of it when he invaded Egypt. But presumably not all the rooms were for people. Stores must have been kept in a number of them."

The first impressive stage of the Pharos was crowned with a terrace. Huge statues of Tritons decorated the four corners.

The Arabs, who captured it in 641 A.D., admiringly reported that the terrace housed other wonderful things. There was, for instance, a rotating statue that followed the sun's course each day with a pointing finger. Another statue musically sounded the hours, they said. Still another—and here they were resorting to unnecessarily tall tales—shouted warnings whenever an enemy fleet set sail for Alexandria.

Above the square first stage of the Pharos rose a slenderer, octagonal one. Above that, a round stage contained the vital fire and reflector. This section was capped with a suitable peak, and on the peak stood the statue of Poseidon, protector of sailors.

Whether beautiful or not, this awesome tower was the talk of the ancient world. It was also the ancestor of all the minarets that followed, architects say, and even of quite a few church steeples.

I asked Dr. Riad how fuel for the

nightly fire had been hoisted to the top of the Pharos.

**Fuel for the Pharos.** "Some accounts mention a very gradual interior ramp that wound all the way to the level of the light," he said. "Donkeys with palm logs strapped to their backs supposedly hauled the wood up this ramp."

Other scholars think it was more likely that there was a big windlass at the top, and that it hauled wood up a center stairwell in baskets.

"Can any bits of the original lighthouse still be seen above water?" I asked.

"Oh, yes," he said, "but very few. The three rectangular stones that frame the entrance door of Fort Kait Bey are unquestionably granite from the Pharos. You'll see other fragments at the fort."

I did see them—odds and ends of the unmistakable purplish-red Aswan granite that the Pharaohs and their Greek successors used so lavishly for their finest buildings and statues. They appeared here and there in the fabric of the sand-colored fort like raisins in a bun.

Northwest of Kait Bey, just beyond the jagged reefs where the blue-green sea seethes and sounds, much more of the Pharos may be resurrected this month. Maybe even the statue that followed the sun with its upraised finger. ■ ■

### "Maxwell" built of plywood



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and special salads and pies aren't just Sunday fare. They are everyday fare—and if a man happens to like steak he can have three of them at a sitting, no questions asked. There are, of course, the usual acey-deucey sessions going on around the clock; a new set of movies for officers and crew each night; a piano in the crew's mess for impromptu sings; and, for the serious guy, a list of college-credit courses he can study toward a degree.

Lt. Bob Hoke, the ship's doctor, told me that the air supply was his most critical job. He and his staff take air samples at frequent intervals and test for toxic fumes and irritants. Huge banks of activated carbon filter out the solid irritants that, in the first nuclear subs, used to cause a painful burning sensation in the eyes, even during sleep. Carbon dioxide (which results from human beings breathing oxygen) is separated out and pumped overboard. Carbon monoxide and traces of hydrogen gas (from cigarettes and the ship's batteries) are collected, converted, and burned in a closed environment. Fresh oxygen is made from sea water. The whole internal atmosphere of the Edison is self-contained, cool, clean, germfree, and fresh-smelling. It is as good after 60 days as it is at the moment of the first dive.

Hoke also monitors the ship steadily in search of radiation "hot spots" that might come from the reactor room—but so far he has not found anything even remotely dangerous. The design of nuclear subs under that irascible pioneer, Admiral Hyman Rickover, has proved about as close to perfect as it could be.

**An "outboard," too.** Even if the nuclear reactor fails, and its diesel backup fails, and the batteries fail—the ship can be brought safely into port by her "outboard motor"—a small propeller on a shaft that can be lowered out of a hole in the bottom and can put-put the ship home, using its own batteries and/or diesel power.

Off Cape Hatteras, in deep water, Captain Dedrick put the Edison through her paces with no holds barred. The word was passed to rig for violent maneuvering—and that was what they meant. Bill Morris and I were manning our usual battle stations beside the thickshake machine when suddenly the deck tilted like a coal chute, and we had to grab to keep from sliding forward into the torpedo room. The squawk box then invited Morris and me to come to the control room, if we cared to, and see the operation at its source. We made it, going from handhold to handhold.

When I looked at the depth gauge I felt a sudden catch in my stomach. It was registering deeper than I ever expect to be again—deeper by far than I realized a submarine *could* go. The reading, of course, is classified. So is the reading of the speed on the dial nearby.

But I think the banking angle is okay to talk about. It was like being in a dogfight in a World War II fighter and seeing the top of your opponent's head on the other side of the turning circle. One thing I will say positively: Whatever you hear about how fast, maneuverable, and deep-diving a nuclear submarine is, believe it.

**A perfect cruise.** When we went ashore at Yorktown, Va., two days later, we'd traveled up the Atlantic coast submerged in deep water. At no time was there any malfunction, dangerous situation, or loss of positive control. The Edison, moreover, is a very happy ship. Captain Dedrick is a first-class skipper: deeply informed in his job; strict with himself and his crew in matters of importance; no nit-picker on the little details; and a man who knows the value of a liberty. (A liberty is to relax in—and if relaxing means getting smashed to the tops of the ears, let it happen.)

If all of the 41 Polaris submarines that this country will eventually have on defense patrol are as well-made and well-manned as the Thomas A. Edison, this country can afford to relax a bit. ■ ■





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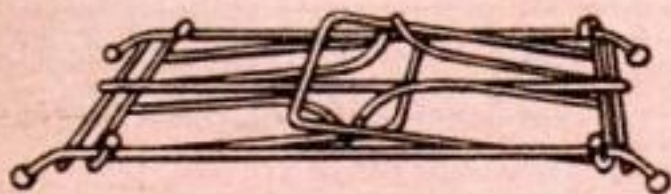
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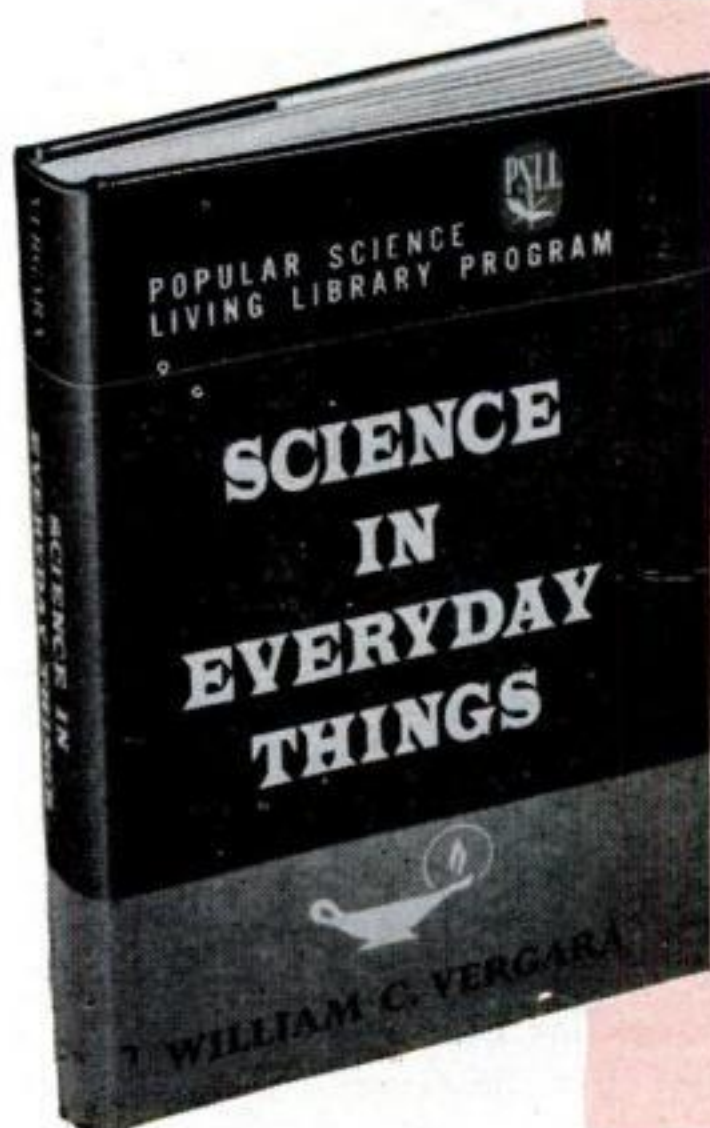
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burn. The biggest conflagration that the U.S. has yet suffered was a forest fire in Michigan and Wisconsin, in October, 1871. It destroyed 5,900 square miles.

Clouds, which cover much of the U.S. on an average day, give some protection. They would reflect heat rays back, away from the ground. A dense smoke screen—if you had time to put one up—might block 90 percent of a bomb's heat.

**How to poison a country.** Doomsday No. 3 is radioactivity. Technically, it is not quite so easy to poison every human being on earth as Nevil Shute indicated in his chilling novel, *On the Beach*. If you are willing to settle for depopulating one continent or one country, however, it's not so difficult. W. H. Clark, a physicist whose specialty is ICBM nose cones, has paid more attention to the facts of science than Shute did and has figured out poisoning feasibility in appalling detail.

Clark envisions *very* large H-bombs—a few thousand megatons each. Nothing like that has been made yet, but no one doubts that they could be made. If they were built as giant mines—towed in place by submarines—and detonated about two miles down in the sea, they would cause tidal waves. The crests would reach 100 feet and more, flooding coastal cities.

Such bombs would become real country-busters, however, if they were deliberately designed to be "dirty": to produce large amounts of highly radioactive fallout. They might be wrapped with sodium oxide. The sodium would absorb neutrons from the fusion reaction and transmute into sodium-24, which is very nasty stuff.

One sodium-wrapped bomb of the 20,000-megaton size would dust 200,000 square miles (an area equivalent to Illinois, Indiana, Wisconsin, and Iowa) with 1,000,000 roentgens of sodium-24.

"This," says Clark, "would destroy all animal life, including people in an average basement bomb shelter, all active vegetation, and nearly all seeds. The

landscape would be temporarily transformed to lunar desolation. . . . A man would collapse in 10 minutes."

Sodium-24 is so rapidly lethal because it decays very fast. After 15 hours, half the radioactivity is gone. People could survive if they got down into very deep shelters immediately—before the fallout settled—and stayed underground for a week or so.

But this escape hatch can be slammed. The bomb could also be wrapped with cobalt. It transmutes into cobalt-60, which is very radioactive but decays slowly. Heavy fallout of cobalt-60 would remain lethal for years.

A bomb salted with cobalt alone is a poor weapon just because it works so slowly. Clark points out: "Killing the enemy by inches is not only inhumane, but while dying he may do unpleasant things to whoever caused the fallout." A combination of cobalt and sodium makes the country-buster: The sodium-24 would knock out those who didn't get into deep shelters, and the cobalt-60 would immobilize those who did.

**Why build them?** Country-busters like these weapons could probably be perfected within five years or so. And not just by the United States and Russia. Less well-heeled nations—France, China, even Cuba—have the know-how and possibly the inclination to try.

For example: Suppose the Chinese Communists secretly mined the oceans along both our coasts with Clark's radioactivity bombs. And then they demanded, "Give us domination over all the Far East—India, Japan, everything—or we will utterly destroy North America." If the threat were plausible, nothing we could counter-threaten with ordinary ICBMs and H-bombs would deter them. The choice between surrender and suicide is easy to predict.

**Real Doomsday Bombs**—designed to destroy not a nation or a continent but to kill everybody—could probably not be built for at least a decade. Such a weapon would take more explosive than



## Man's Last Big Blast

any country now has in its stockpile. Clark estimates that wiping out the human race would require more than a million megatons. Another scientist, Freeman J. Dyson, figures that 3,000,000 megatons would be needed to kill half the earth's population. One informed guess of world stockpiles: U.S., 30,000 megatons; USSR, 3,000 megatons.

You might think that a real Domsday Bomb, if built, could never actually be fired: Whoever pressed the button would kill himself along with everybody else. It's a reassuring idea, but it might not stand up.

Suppose a war starts small and then gets bigger and rougher until one side is beaten to its knees. Destruction and death for the leaders on that side are inevitable. Might that side not threaten: "Stop now and let us off easy, or we will take the whole world with us into Hades"? And mean it.

**Is Domsday coming?** The terrible possibilities of Domsday Bombs affect not just strategy, but also diplomacy and even domestic affairs. Fallout shelters, for example. Domsday is a favorite topic of people who oppose shelters. They point out that no simple shelter can protect against global fire storms or torrents of radioactivity. So, they argue, shelters create a false sense of security that may increase the chance of war.

Yet there are some rays of hope. Complete Domsday Bombs do not exist yet, nor (probably) do their predecessors. No nation is likely to have any *usable weapon* bigger than 15 or 20 megatons for several years. The Russian's gigantic blast was a test explosion, not a weapon demonstration. So right now, shelters would protect many people against the "most likely" war.

Moreover, the most abhorrent tactics are not always used. Poison gas was stocked but never released in World War II; so also with bacteriological warfare. There are always some people in every country who prevent national suicide.

So far.



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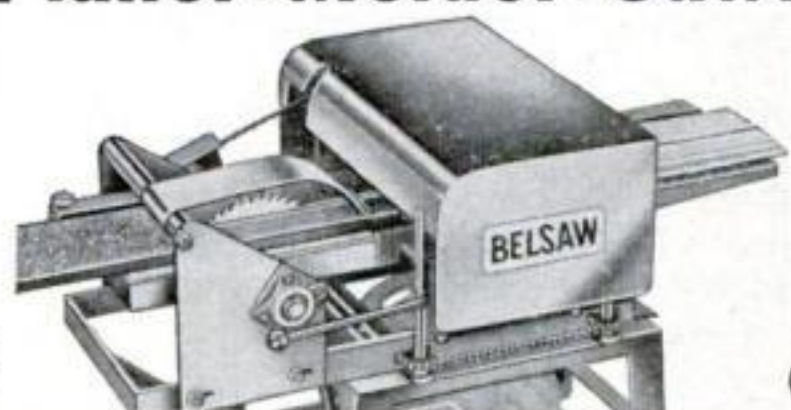
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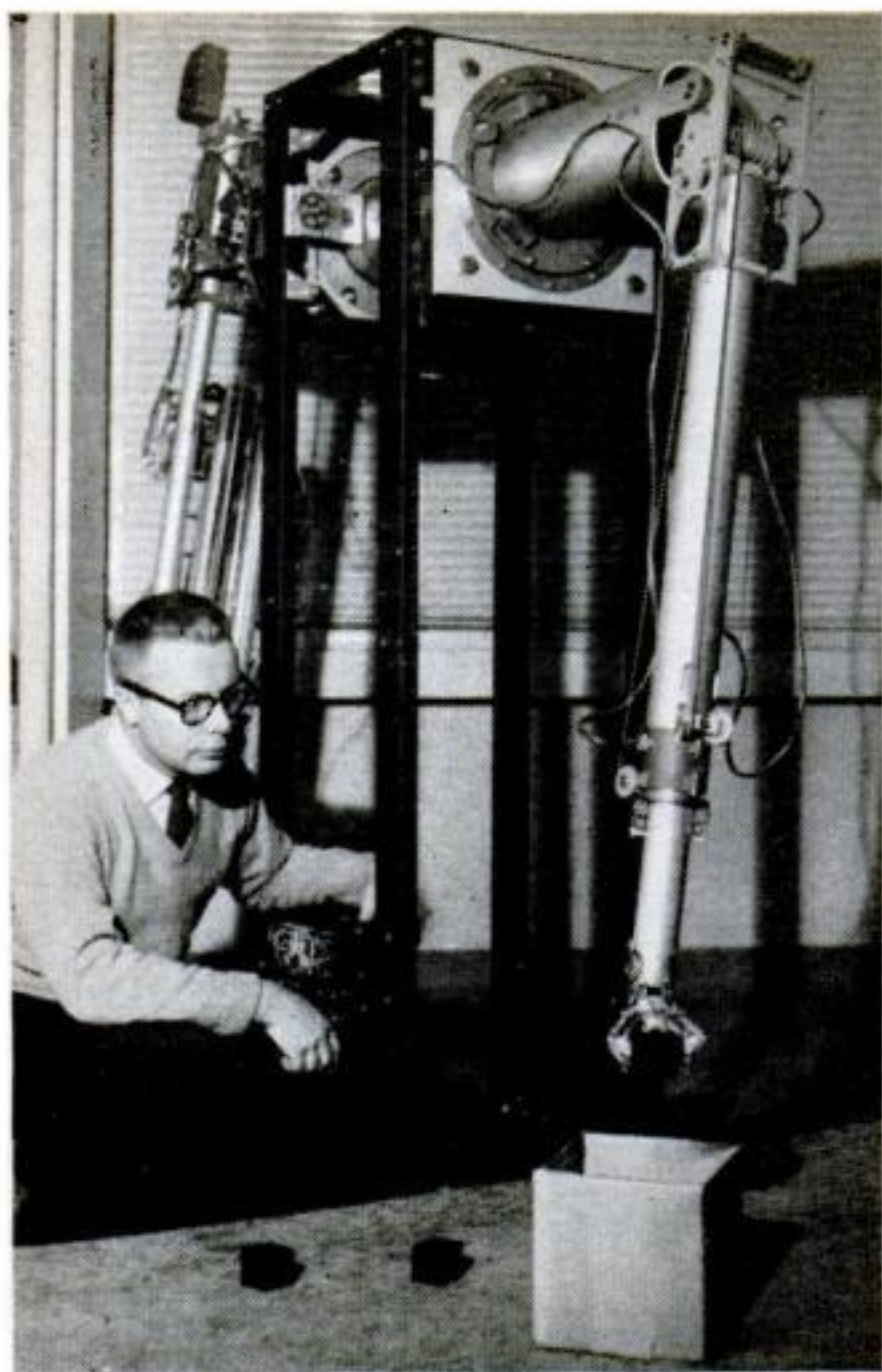
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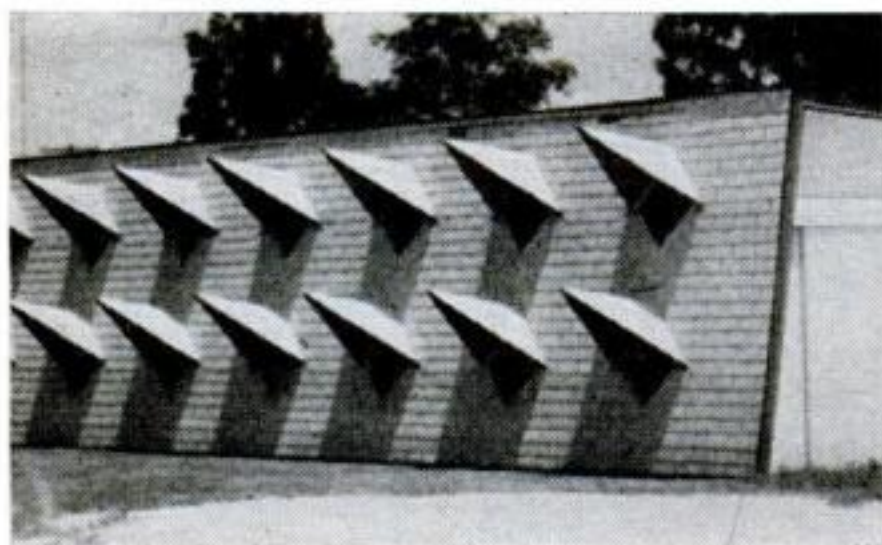
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### Machine with intelligence

Equipped with 30 sensing devices and combined with a computer, this robot hand, so far, has been able to determine the size of blocks by feel, stack them in piles, or put them in a box. Developed by Dr. Heinrich A. Ernst of M.I.T. for a study of artificial intelligence, the robot might find use in space exploration.



### Awnings match diamond windows

Triangular awnings cap diamond-shaped windows in an interior decorator's building in Plant City, Fla., to serve a double purpose. Besides shading the windows from the heat and glare of the sun, they keep strong winds from driving rain in.

### Most Complicated Building Ever Built

[Continued from page 72]

as a helicopter port. Trial flights are projected in the fall of 1963, as a step in obtaining the required approval of Federal and other aviation authorities for regular air service. If this approval is forthcoming, the top of the Pan Am will become the first public airport in the midtown heart of the city—and new twin-turbine, 25-passenger copters will shuttle between it and the city's outlying air fields.

**Ant-hill engineering.** Because the Pan Am rises squarely over Grand Central Terminal's railroad tracks, its elevator pits (for shock-absorbing safety buffers) must be on its street floor. This is why the elevators start at the second story. Also for lack of a basement, refrigerating machines had to be dramatically hoisted to an air-conditioning plant more than 750 feet up—and raising a 27-tonner set a Manhattan weight record for so high a lift.

Erecting the Pan Am was a succession of unique engineering feats. A six-story building that formerly occupied the site was still being razed when the new one began rising beneath it. Footings and columns had to be installed in the very midst of the rails of Grand Central's cavernous train rooms, but careful timing of operations enabled train service to go on as usual (needing merely to be diverted from two adjacent tracks at a time).

Solid as it looks, the new Pan Am Building was constructed in two distinct parts that will remain entirely unconnected: the street floor, resting on the former building's columns; and all the floors above, supported by stiltlike new columns and shielded from vibration as illustrated.

As the finishing touch, the Pan Am's exterior has been assembled of eggshell-white panels of precast and textured concrete. Contrasting bands of glass and aluminum mark the 21st and 46th stories. At night, flood lamps will transform the latest addition to New York's skyline into a shaft of light. ■ ■



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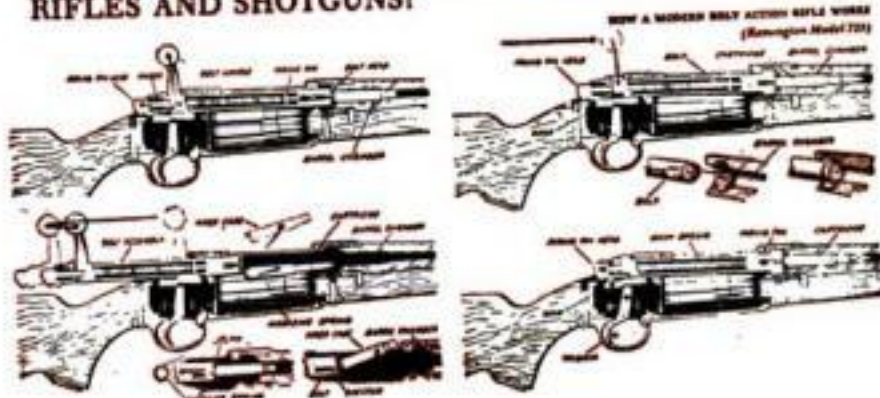
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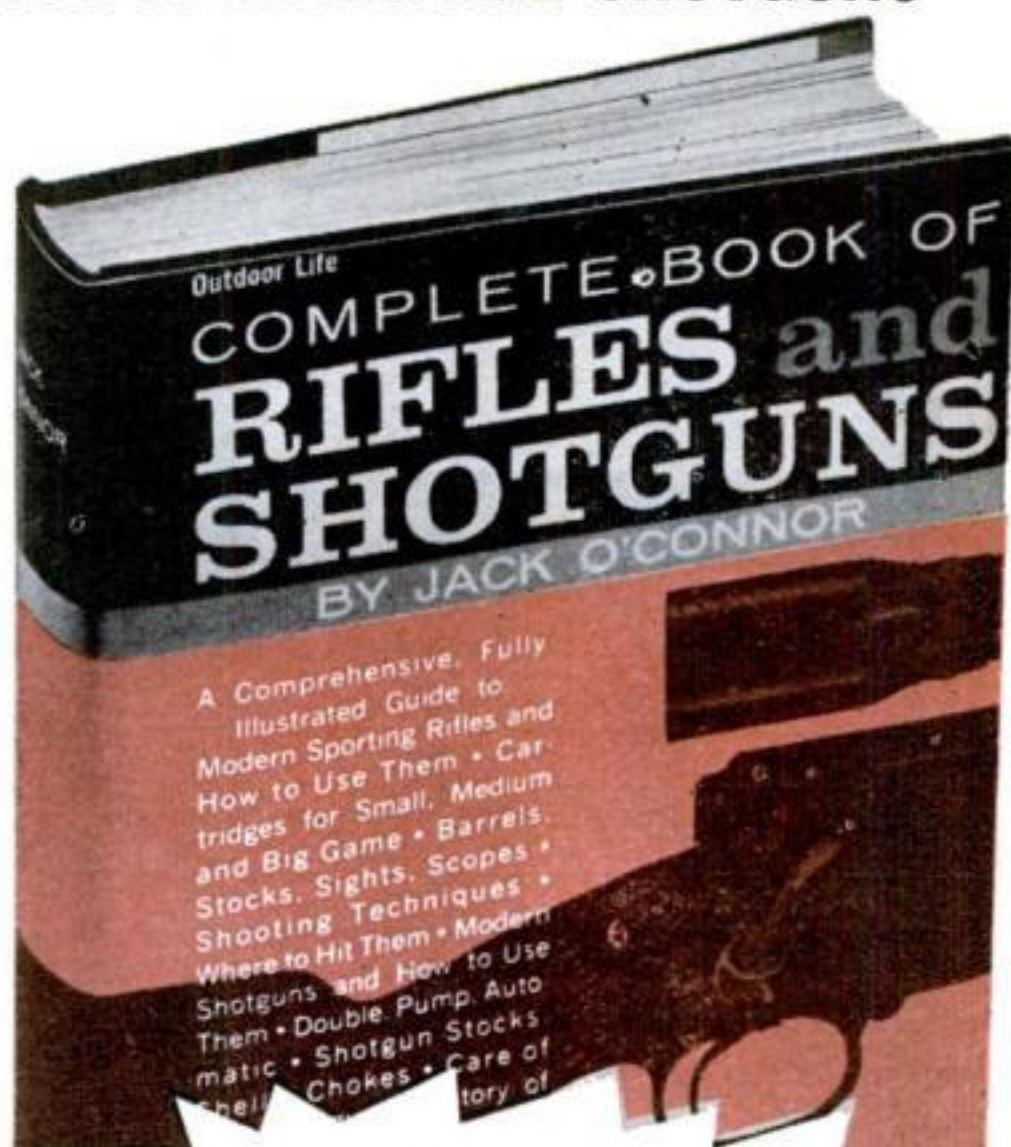
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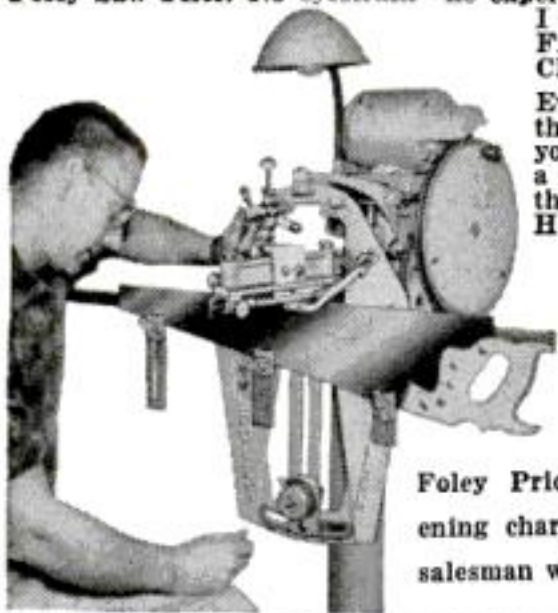
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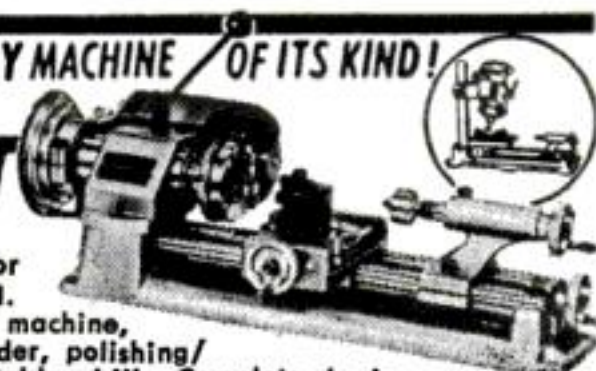
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## What's the Stuff Good Boats Are Made Of?

[Continued from page 140]

production for themselves at a fraction of the cost. A point to remember: Buy from an established manufacturer, as you can't tell a good boat from a bad one by appearance. The glass and resin vary in quality, and low grades (and insufficient amounts) used by fast-buck builders cheat you of the toughness you're paying for.

If you want to cut costs, build your own boat with quality materials. You can use an old wooden hull for a mold. Lay up the glass blankets directly on the old hull and lift off a new fiber-glass hull when the resin has hardened. Round bilge types are best for fiber-glass, and details are available from material suppliers. Or you can use flat sheet fiber-glass in plywood fashion over a close-ribbed wooden hull frame. It won't be a one-piece unit, but it'll be just as resistant to puncturing as any fiber-glass.

Generally a fiber-glass hull shell runs about half as thick as its plywood counterpart, but at  $\frac{1}{8}$ " it has much more flex than  $\frac{1}{4}$ " plywood and needs more stiffening. It gets it in lightweight style from curved hull sections, molded-in framing, sandwiched foam flotation, or all three. One of the easiest boat materials to repair, it's also so hard to damage that Lloyd's offers a 15-percent insurance cut to customers of Britain's Halmatic Co., molder of the world's largest fiber-glass yacht, the 67' Ocean Commander.

Plywood's latest contribution to speedy and better boatbuilding is a special marine grade that needs neither sanding nor undercoating, never shows grain, won't blister, crack, or swell, and is guaranteed never to delaminate. The fast-finishing trick is in a satin-smooth phenolic-impregnated cellulose-fiber skin that U.S. Plywood calls Duraply. Inside, it's regular marine plywood, which has had many an undeserved insult from amateur boatbuilders and back-yard pros who don't know there's a big difference between exterior grade and marine.

Both grades are waterproof-phenolic-glued, but exterior grade is designed for flat applications. So Douglas Fir Plywood Association rules allow large core voids, 1" knotholes, 18 surface patches per panel, and either sapwood or heartwood faces. In a sharp bend a large core void may crack or split, and an absorbent sapwood



## What's the Stuff Good Boats Are Made Of?

face isn't any boon to a good boat finish.

Marine grade limits core voids to  $\frac{1}{8}$ " in a single layer, bans inner-ply knotholes, allows only six surface patches. And faces must be heartwood, less absorbent, more rot-resistant. It takes sharp bends, holds paint, and lasts indefinitely. Cost of top quality  $\frac{1}{8}$ " is about 30 cents a square foot. Enough for that 8' pram: about \$20. It'll be in any factory-built boat you buy. Be sure you get it when you buy from an unknown or build your own. Seal the seams with resorcinol resin and your hull's as dry as one-piece fiber-glass.

**Wood planking**, traditional source of calking chores, is now calked permanently at the factory by manufacturers such as Gerber's Boat Works, who edge-glue thoroughly seasoned planks with the same resorcinol resin glue. Stronger than the wood itself, and so waterproof that acid baths and boiling won't weaken it, the glue locks seams for good so they can't leak or "work" under stress. It's a boon to racing classes whose rules require planking. Gerber uses it on Lightnings.

**Welded steel** cruisers start from around 25', approximate fiber-glass in toughness, and are often lighter beyond 40'. You can figure on a bottom about  $\frac{3}{16}$ " thick, the rest around 11 gauge. Like fiber-glass, the steel jobs are an easy match for floating logs and have bounced off rocks at 30 m.p.h. with mere scratches. The steel will be an alloy like Inland Steel's Hi-Steel or U.S. Steel's Cor-Ten. These are about five times as corrosion-resistant as carbon steel, hold paint  $2\frac{1}{2}$  times as long. Their strength (yield point) is almost double that of carbon-grade structural steel, so overall weight can be cut by up to 25 percent.

Modern finishing takes care of corrosion. Inland Seas Boat Co., with 5,000 hulls in service, uses 10 vinyl spray coats on the bottom, 6 elsewhere, and hasn't had a corrosion kick in its 16-year existence. A 210-hp. 26-footer sells for about \$6,800.

In the little bathing-suit boats you'll find high-density polyethylene and foamed polystyrene. The foam also makes ideal block floats for your private dock, if you're lucky enough to have one. But it has an odd allure for seagulls. They like to peck at it, although they don't eat it. But again, modern technology comes to the rescue. Coat your foam with bright orange paint and the seagulls keep away. ■■

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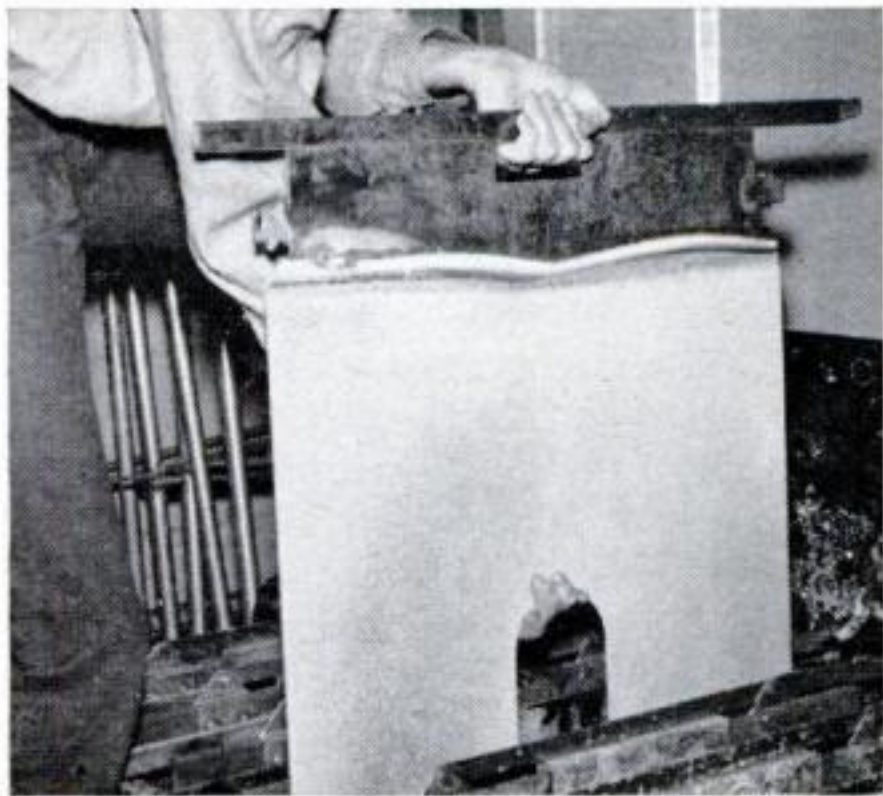
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## Blower cleans out street cracks

An air hose on the front of street-maintenance trucks in Phoenix, Ariz., blows dirt out of cracks in pavement to be repaired. A vehicle that lays hot tar follows to fill the cracks. The air comes from a compressor inside the truck cab. It's fed into a length of pipe perforated on the bottom and mounted on a swivel joint so it can be swung at an angle to clear out irregular cracks. The device, built by two street-department foremen, does the work three times as fast as when a cleaner on foot precedes the tar layer.



## There's silver in that thar hypo

A mine that pays \$10,000 a year is operated by the Naval Photographic Center at Anacostia, D.C. The pay dirt: excess silver from the emulsions of film and photoprints "fixed" in hypo solutions. Stainless-steel sheets dipped in the hypo (above) are plated with silver by electrolysis. Hammered off, the metal is sent to the Treasury.

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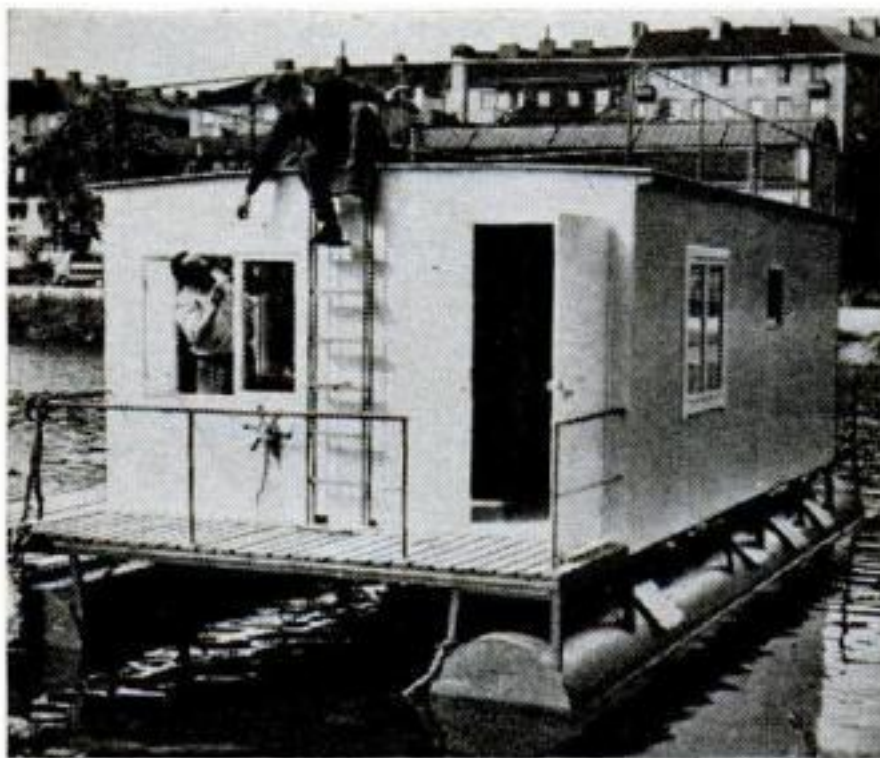






### Bus's "gas" rides piggyback

The upper level of these buses in Communist China's capital city of Peiping isn't for extra baggage, laundry, or passengers. It's for the fuel on which they run: natural gas carried on top in an inflatable sack that looks like an overstuffed duffel bag. The leading bus appears to have a full tank but few riders; the one behind seems to have neither.



### Homemade Swedish houseboat

A well-equipped deckhouse mounted on improvised pontoons serves as year-round headquarters for Capt. Elving Attefors, director of the Stockholm Seamen's School, and engineer Evald Sjolund. The two men built the houseboat for summer and winter use. It has a "porch," a sun deck on the roof, two cabins with double beds, and a complete modern kitchen. An outboard motor powers it.

bomber and (as you can see on page 59 of this issue) deep down under the sea in an atomic submarine.

In those more than two decades, he set new standards of photographic excellence in his specialty, things scientific and things mechanical. If POPULAR SCIENCE has prized his pictures, so have government, industry, and educational institutions. Extra prints of his work have been in frequent demand.

Bill can look back on vast changes in equipment and technique in magazine photography since 1940. When he joined the magazine staff, newspaper- and Navy-trained, he used the customary equipment—a 4-by-5 Speed Graphic. Photographers are a stubborn lot. To a man, they refused to use range finders and exposure meters, or to try side-lighting. Bill Morris early learned that a range finder and an exposure meter improved his pictures. He experimented with side- and back-lighting. But, like his fellow cameramen, he disdained smaller cameras.

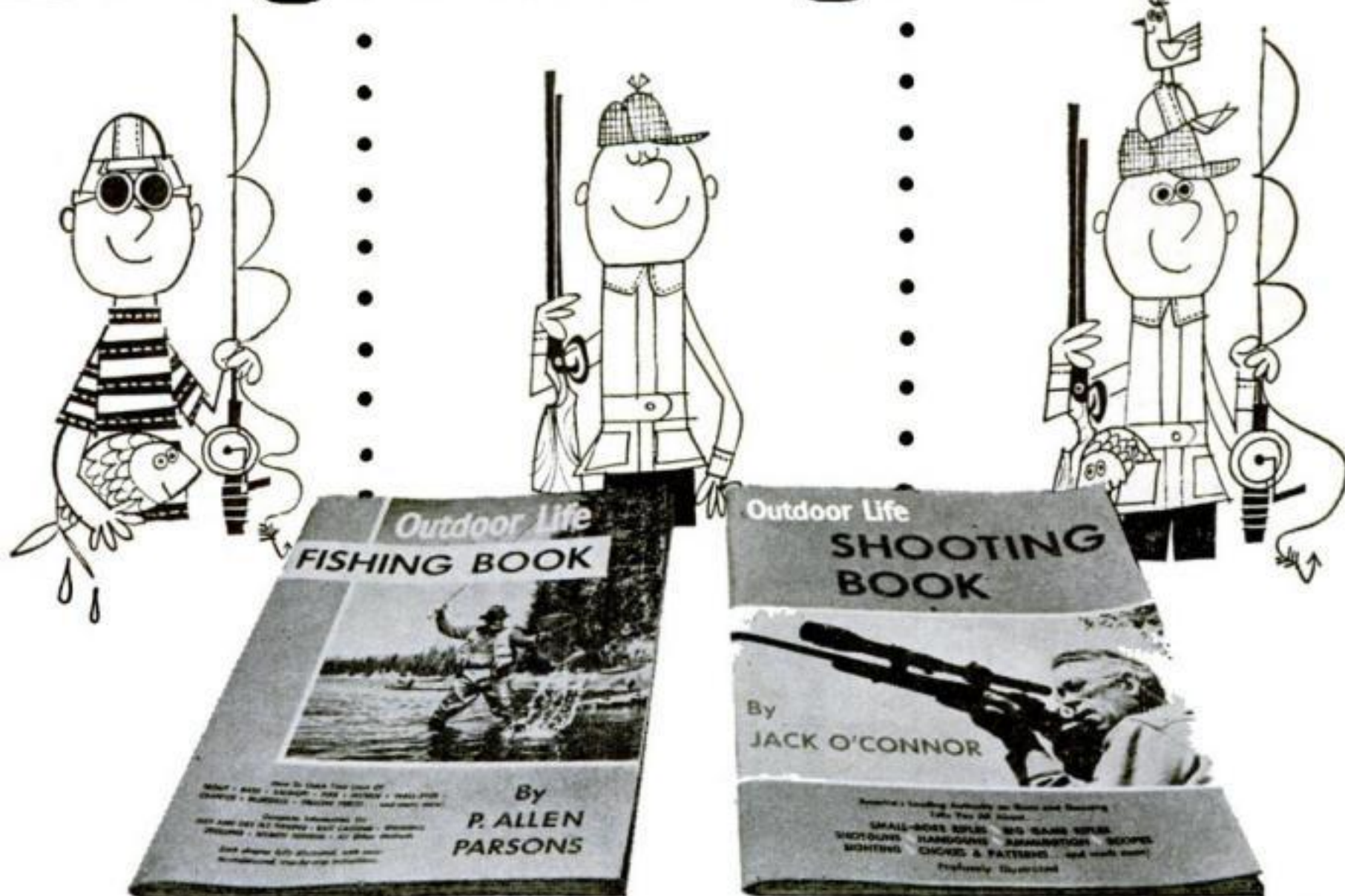
*The weight penalty* for this was high. Bill Morris had to lug around not only his camera but 40 to 50 film holders, flash-gun equipment, extension cords, and cases of flash bulbs as well. Even without bulbs, he trudged through his assignments with an 80-pound load.

By 1946 cameramen had begun to be won over to the 2¼-by-2¼ camera, such as the Rolleiflex. Electronic flash became popular. The weight of the equipment fell by half. Today the large majority of POPULAR SCIENCE "location" pictures are shot with small cameras and strobes. Better film, of course, helped make this revolution possible. Bill Morris has lived through an era.

To regard Bill Morris as retired, after so active a life, is naturally absurd. Nimble and tireless despite his 210 pounds, he will go right on taking pictures. Bill and his wife Jerry have two sons, Peter and Bill Jr. They, too, are pretty handy with cameras. They ought to be. Their dad trained them. ■ ■



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**MAKE Money sharpening** saws, tools, knives, scissors, surgical instruments, etc. Grinding outfits low as \$34.95. Manual Furnished. Write Treycor, N. Tonawanda 1, N. Y.

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**STOP Throwing Away Boxtops!** They're worth money! Some. 25c! Inquire: "Box-tops-DG", Cedar Hill, Texas.

**SHARPEN** saws and lawnmowers the profitable way. Send for free literature. Max Manufacturing Company, 138 Stockton Avenue, San Jose 26, California.

**\$300 WEEKLY** possible! Most successful home operating moneymaking business plan of all time. Information free. Oliver Miller, Strasburg 1, Virginia.

**WORLD'S Largest** wholesale supply. Buy from 679 American, European, Japanese wholesalers. Tailormade suits from Hong Kong. 123 dropship catalogs. Rockbottom prices. Free details. International Buyers, 216-PS2 Jackson, Chicago 6, Illinois.

**MAILORDER—400% profit.** Equipment \$3. Sample 25c. Interstate, 37-9 Besch, Albany 9, N. Y.

**PLASTERCRAFT** molds, liquid rubber, plasters, flocks, candle supplies. Catalog and manual free. Jayhawk Plasters, Blue Rapids, Kansas.

**SELL Champion, AC, Autolite** spark plugs. Reconditioned, electroplated, guaranteed 10,000 miles. 100% profit. Free sample. Lee Plugs, 1608-K Roberts, Houston 3, Texas.

**OPERATE Home** mailorder business. Vosacek Printing, 4444-PS Ute, San Diego 17, Calif.

**FREE** wholesale directory lists—350,000 items. Dean's Box 40-PS, Eiberton, Ga.

**OPPORTUNITY — Profitable Mailorder Business.** Lamar Specialties, Box 567, La Marque 1, Texas.

**PEST Control.** Start own part, full time business. Charge \$10.00 hour! Elston, 4035 Lake-Cook, Northbrook 2, Illinois.

**FIVE Mailorder Winners.** Circulars for Mailing Free. Box 936 (X), Wichita, Kansas.

**HOW to start** profitable small diner, lunchroom. Home training. Details Free. Restaurant Business School, Dept. FC-92, 1920 Sunnyside, Chicago 40, Ill.

**AVOID Trouble.** Order latest mailorder business "Legal Guide." Explains all about licenses, taxes, etc. \$2.00. Neil H. Tasker, Shamokin, Pennsylvania.

**UNUSUAL Formulas, Home businesses,** mailorder. Write Southland, 401-D East Jackson, Orlando, Florida.

**CLIP Items** from your daily Newspapers. Profitable sparetime work. Our New, Sound, Tested Pollo tells how easily it's done. For Details write, Direct Mailorder Service, Box 529-PS Riverdale, Dayton 5, Ohio.

**INVESTIGATE** new mail order drop shipment plan. OPCO, 13389 23rd Place, Golden 3, Colorado.

**"PROFITABLE Mail Order Businesses Directory."** 25c. Mail Dealers Headquarters, Box 64-S9, Rego Park 74, N. Y.

**"HOW and Where to Obtain Capital."** Reliable Service, Rome City, Indiana.

**MOLDS** for Concrete Bird Baths, Benches, Flower Urns, Animals, Statuary Items, etc. Buy durable Aluminum Molds direct from Top Manufacturer. 96-page Manual complete instructions, product illustrations, mold prices, \$2.00. Concrete Machinery Company, Inc., Drawer 99, Hickory 17, N. C.

**MEN!—Women!** Make money raising bait at home for us! We buy your crop! Details free. Red Wigglers, Warsaw 3, Indiana.

**ASSEMBLE Artificial Lures** at home for stores. Materials supplied Free. Profitable! Write: Lures, Ft. Walton Beach 8, Florida.

**I Made \$40,000.00 Year by Mailorder!** Helped others make money! Start with \$10.00—Free Proof. Torrey, Box 3566-F, Oklahoma City 6, Oklahoma.

**\$200.00 MONTHLY.** Spare Time. With Tablesaw, Bandsaw or Jigsaw. Write, Holiday House, B3800 Harney, Vancouver, Washington.

**MOLDING Rubber, Shells, Flowercraft.** Free Information, Chaney's, 5415-C San Jose Blvd., Jacksonville 7, Fla.

**HOME Business Confidential—Best opportunities** not widely publicized—Never Overworked! Send postcard for free "Inner Circle" listing. S-M Research, Box 432-P, Detroit 31, Michigan.

**80% PROFIT** operating lucrative mail-order business. Tested plan. No capital. Free information. Southwest Sales, Dept. PS-9, Cleburne, Texas.

**MAKE flexible molds,** cast plaques, figurines. Sample 10c. Karr, Hayes, Hamilton, Ohio.

**ARE you just getting started in mail order?** Or are you an "old timer?" Whichever you are, you'll benefit by reading, "How to Make Money Through Classified Advertising." It tells you what, where, when and how to advertise, points out what to do, and what to avoid. Thousands of copies of this booklet have already helped mail order men all over the world. To get your copy, just send 10c to cover postage and handling to O.K. Kelly, Dept. 962, Popular Science Classified, 355 Lexington Avenue, New York 17, N. Y.

**MAKE \$46 From Square Foot Plywood;** Jigsaw necessary. Free Details. Woodarts, Bridgewater, Mass.

**DOES Well-paying Research** interest you? Or operating Telephone Answering Service? Write: Murrey's, Litchfield, Maine.

**BAKE New Greaseless Doughnuts In** Kitchen. Sell stores. Free recipes. Summers, 3605 South 15th, Minneapolis 7, Minnesota.



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**HONEST** Help for home mailorder. \$1000 monthly possible. Write. Murrey's, Litchfield, Maine.

**FREE** Report "609 Odd, Successful Businesses." Box 1001-H, Evanston, Ill.

## 37A INVESTMENTS

**ADVICE?** No. Common Sense? Yes. Read "Common Stocks and Common Sense," the first practical layman's approach to investing. 64-page guide to understanding the stock market, only \$1.00. Gordon Publishing Co., R2, Muskego, Wisc.

**FOR** Fun and Profit in Coins, Write Me. Putz, Box 913, Port Jervis, N. Y.

## 38 MONEYMAKING OPPORTUNITIES

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**SECOND** Income from Oil can end your toil! Free book and oilfield maps! National Petroleum, Panamerican Building-PS, Miami 32, Florida.

**DETECTIVES**—Work home—Travel. Experience unnecessary. Detective Particulars free. Write Wagoner, P-125 West 86th, New York 24.

**MAKE** Plastic novelties for extra income. Low cost home training now available. Write for free booklet. Interstate Training Service, Dept. D-2, Portland 12, Oregon.

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**\$100 WEEKLY** possible. Compile Mailing lists and address envelopes for advertisers. Home-spare time. Particulars free. National Service, 81, Knickerbocker Station, New York City.

**FREE** Literature — Make Big Money Raising Fishworms and Crickets. Carter Farm-11, Plains, Ga.

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**MINK** Raising information free. Complete. Lake Superior Mink Farm, Superior EE, Wisconsin.

**EASY** to start rubber stamp business at home in spare time. Make up to \$9.80 an hour without experience. Facts free. Write to Roberts, 1512 Jarvis, Room CR-3-H, Chicago 26.

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**CRUCIFIXION** of Jesus: Marblerock cast—beautiful Gold Plated—weighing 1/4 Lb., height 5 1/2"—retail \$2.00 each—Wholesale \$7.00 Doz., Prepaid. Sample \$1.00. Hall Gift Products, 119 South Calverton Rd., Baltimore 23, Maryland.

**I'LL** Send You full-size famous Blair home products for Free Trial, to help you make more money, spare time or full time. Show friends, neighbors, take easy big orders, make generous profits. Write Blair, Dept. 55FS, Lynchburg, Va.

**MAKE** \$25-\$50 week, clipping newspaper items for publishers. Some Clippings worth \$5.00 each. Particulars free. National, 81, Knickerbocker Station, New York.

**DISTRIBUTE** leading Mail Order Magazines. Details, Samples 10c. Frankland Enterprises, P.O. Box 112, Chicago 17, Ill.

**MEN, Women, Turn** spare time into cash! Taylor Enterprises, Export, Pennsylvania.

**MAKE** Up to \$50.00 a day soliciting delinquent accounts. Terrific commissions. Write today. General Finance, 304H Pickwick Bldg., Kansas City 6, Mo.

**MONEYMAKING** Opportunities Galore. Details Free. Gay-Tex, 4105 Metropolitan, Dallas 10, Texas.

**\$128** IN sales from \$10 Material! New—Different! Free information. Frison-PS9, Box 3122, Seattle 14, Washington.

**LEARN** the secrets of repairing junk batteries, generators, starters, profitable, easy, at home. Free particulars. Batteryman, 3465 Forest, Santa Clara, California.

**FANTASTIC** profits in safe investment plan. Write: Research, 422 Laurel, Skippers, Va.

**EXTRA** income, mailing advertising. Refundable literature 25c. Keystone Distributors, Box 206, Pottsville, Penna.

**CONCRETE** Drain Tile. Want to make them? We have the machine. Thorough Data 25c. CMC, Drawer M99, Hickory 17, N. C.

**OPERATE** collection Service. Send \$3.00 for equipment. You'll make money immediately, or money back. Creditors Service Company, Murphy, North Carolina.

**\$7.50 HOUR**—home sparetime. Experience unnecessary. New Printing Method. Daltonn, 5922 Metro. Station, Los Angeles 55, California.

**PLASTIC** production in your home. Hundreds of parts per hour. Signs, toys, models, etc. Dynavac, Dept. S, Box 94, Oceanside, N. Y.

**IF** you have a product or service which can be sold by mail order, don't fail to read the new booklet, "How to Make Money Through Classified Advertising." Just send 10c for your copy to O.K. Kelly, Classified Adv. Mgr., Dept. 962, Popular Science Monthly, 355 Lexington Ave., New York 17, N. Y.

**CIGARETTES**—Make 20 plain or filter-tips for 9¢. Facts free. Moberly, Box 4013, Owensboro, Kentucky.

**COMET** Advertiser Opportunity Magazine, Sample Copy 25c. Lawler Enterprise, Atlantic Highlands, N. J.

**MAKING** Beautiful Plastic Products, Per Our Easy Instructions. Your Greatest Money-Making Opportunity. Write For Proof. Plasticon Company, Box 105, Grove City, Penna.

## 38A BUY IT WHOLESALE

**FREE!** Name Brands Catalog! Your own high profit business. Sell Name Brands, full or part time. No inventory—no investment. More than 2000 Name Brand items; lowest wholesale prices. Watches, jewelry, cameras, hi-fi, stereo radios-phonos, appliances, housewares, hardware, power tools, luggage, musical instruments, garden equipment, sporting goods, toys, many others. 8 Floors of Name Brands. Million dollar inventory. Orders shipped complete within 24 hours. Send for Free beautifully illustrated catalog. Now! Separate wholesale price list. H. B. Davis Corp., Dept. PS, 145 West 15 St., New York 11, N. Y.

**NEW** Deluxe below wholesale catalog. Automobile catalog and others. Furniture, clothing, housewares, appliances, refrigerators, freezers, washers, dryers, television, radios, luggage, binoculars, hi-fi, stereo, phonographs, recorders, cameras, projectors, musical instruments, sporting goods, toys, tools, typewriters, watches, jewelry. Huge discounts on thousands of name brand items. For free specimen list of actual factory prices—postcard: Selbyco, Decatur 16, Illinois.

**LARGEST** Wholesale Supply Source in U.S. 15 free catalogs. Furniture, clothing, appliances, farm equipment, tools, housewares, hobby supplies. Free details. Associated, Box 108-C, Lincoln 1, Nebr.

**TOOL** Catalog Send 25c. Silvo Hardware, 107-PS Walnut, Philadelphia 6, Pa.

**BUY** Direct From Factories! Appliances, Cameras, Watches. Free Details! Cam Company, 436PB Bloomfield Avenue, Verona, New Jersey.

**BARGAINS!** Buy Wholesale! Save Money! Free Catalog! Norris, 273-L Merrick Road, Lynbrook, N. Y.

**DRUG** Sundries. Complete Line Of Rubber Goods. Nationally Advertised Brands. Vitamins Etc. Write For Free Catalog. Federal Pharmacal Supply, Inc., Dept. PS, 6652 North Western Avenue, Chicago 45, Illinois.

**FREE** Money-Saving Catalog. Surplus and newly manufactured equipment and tools for workshop, home, boats, farm, factory. Write: Groban, 1139 South Wabash, Chicago 5, Illinois.

**WORLD'S** Largest wholesale supply. Buy from 679 American, European, Japanese wholesalers. Tailormade suits from Hong Kong. 123 dropship catalogs. Rock-bottom prices. Free details. International Buyers, 216-PS Jackson, Chicago 6, Illinois.

**LAUGH** at "Wholesale" and "Discount" Prices! Buy Almost Everything at Factory Prices plus 5%. 200 Page Index of Top Quality. Nationally Advertised Merchandise. Chicago Warehouse. Guaranteed Reliable! Moore, 1832-A North 5th, North Las Vegas, Nevada.

**ELECTRIC** Guitars, amplifiers, wholesale. Free Catalog. Carvin, PSW, Covina, California.

**SAVE** to 70%! Five free factory catalogs: tools, machinery, ladders, paint, brushes, wood screws, etc. Send 25c. cost of handling. Factory Outlet, P.O. Box 172-PS, Norwalk, Conn.

**100,000** PRODUCTS Wholesale! Terrific Bargains! Wholesalers, 1265 Broadway, New York 1, N.Y.

**WHOLESALE** offers! Importing! Drop-Shipping! Trade Journals! Mail Order Business Opportunities! Write: Importico-1, Enka, North Carolina.

**WHOLESALE** Buyers Service. Name Brands. Free details. Buehlers Bargains, Millersville 3, Ohio.

**SAVE**, Wholesale Catalog \$1.00 (refundable). Travis, Box 612, Austin 63, Texas.

## 38B IMPORT-EXPORT

**BEER** steins, carvings: Mail self stamped envelope; Gonzalez, 3100 Gaston, Dallas 26, Texas.

**SIX** Directories, one cover. Single item wholesale shippers. Japan, Germany, Domestic. Priceless information. \$3. Better Books, 722-PS East Silver Spring, Milwaukee 17, Wisconsin.

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**10,000** PROFITABLE Formulas, Recipes, Trade Secrets. Details Free. Colen, 7731-PSI, Yates, Chicago 49.

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## 40 PLASTICS

**NEW** Liquid casting plastic, clear, colors. Embed real flowers, butterflies, photos, coins. Send 25c for two handbooks "How to Cast Liquid Plastics" and "How to Make Extra Money at Home." Castolite, Dept. K-102, Woodstock, Illinois.

**PLEXIGLAS** — Any thickness — Clear — Colors — Cut to size — Clear Rods — Tubing. McClarin Plastics, P.O. Box 168B, Hanover, Pennsylvania.

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**PLASTIC** embedding and molding made easy with new Instruction Manual, \$1.00, catalog 25c. Castacraft Corp., Dept. S-962, P.O. Box 555, Palo Alto, Calif.

**PLASTIC** Embedding for fun and profit, no oven. Make beautiful jewelry, decorative panels, science specimen castings. Catalog 25c. Natcol Plastics, Box 444, Yucalpa 4, California.



# POPULAR SCIENCE OPPORTUNITIES

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**AMAZING New Book Of Science Experiments,** formulas and Catalogue of Laboratory Supplies. Only 35c. National Scientific Co., Dept. PS-9, 13 S. Park Avenue, Lombard, Illinois.

**NEW Concepts in physics and astronomy,** including a structural system for the subatomic particles. Nuclear theory challenged. 25 cents postpaid. C. F. Kraft, 4809 Columbia Road, Annandale, Virginia.

**MICROSCOPES,** accessories, prepared slides, supplies, etc. Free brochure. New England Science Service, Westmoreland, New Hampshire.

**CHEMICALS and apparatus for industrial, analytical and private laboratories.** Catalog 35c. Dept. M-26. Biological Supply Co., 1176 Mt. Hope Ave., Rochester 20, N. Y.

**UNUSUAL Chemistry books, courses, kits!** Rare chemicals, cheap! Catalog 25c. National, Box 133-A, Palo Alto, Calif.

**MICROSCOPES,** Varimex Brand (European), educational, research, industrial, other. Scientific catalog 25c. Magnification Instrument, 2 East 45th, New York 17. OX-7-8978.

**THEORY opposing Relativity.** Booklet 25 cents. Send for particulars. Mackintosh, 11961 Montana Avenue, Los Angeles 49, Calif.

**CAUTION!** Your science projects just aren't complete without our chemicals and apparatus. Bargain prices to suit your budget. Send Today! Catalog 25c. Tower Chemical, P.O. Box 3370, Grand Central Station, New York 17.

**ILLUSTRATED Catalog:** Chemistry, mineralogy, biology 25c. Tracey Laboratories, Evanston, Illinois.

**LABORATORY Conversion Charts With Bigger Catalogue—25c.** Hagenow Laboratories, Manitowoc, Wisconsin.

**SEND for free Experimenter's Dream Catalog,** for advanced amateurs in all sciences. Ohioans: Visit our unusual science store. Frey Scientific, 273 Orange, Mansfield 5, Ohio.

**WUMCO Chemical Co., Chemicals and Chemical Apparatus.** Catalog—25c. Booklet of Experiments—50c. Box 681, Reading, Penna.

**ECONOMICALLY Priced Laboratory Supplies!**—Catalogue And Gift—25c. Starr Scientific, Manitowoc, Wisconsin.

**ROCKET Amateur Supplies, Chemicals, Engines, Instruments.** Big New Catalog 25c. Central Rocket Co., Waupaca, Wisc.

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**FOREIGN Employment information.** Europe, Africa, Asia, South America. Free Transportation. Up to \$1600.00 monthly. Sensational opportunities. Construction workers, clerks, truck drivers—every occupation. Complete information, application form, sent immediately by return mail. Satisfaction guaranteed. Only \$2.00 (\$2.25 airmail) (C.O.D.'s accepted) to: Jobs, P.O. Box 50512, Dept. F, New Orleans 50, Louisiana.

**THOUSANDS of Government jobs available.** Details Free. Globe, Box 814-V, Macon, Georgia.

**TREMENDOUS Opportunities.** U.S.A.—Overseas—Choose Jobs—Locations—Transportation—Free Details. International Occupations, International Airport, Box 100M-3, Jamaica 30, N. Y.

**JAPAN! Exotic Orient.** Many hi-paying jobs available. Complete, detailed reports. \$2.00. Japan Reports, Box 2202-E, Newport Beach, California.

**AMERICAN and Foreign Jobs.** Laborers, Clerical, Mechanical, Professional. Up to \$1600.00 Monthly Plus Benefits and Transportation. Send \$1.50 (\$2.00 Airmail) for complete "Directory" to International Employment, Box 307, Bedford, Indiana.

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**EVERY Man A Prospect.** Refundable sales kit offer showing line belt buckles, tie clasps, money clips, cuff links, lapels, identification badges, individualized with customer's name and emblems. Cap badges for trucking, bus, taxi, police, firemen, also heavy construction emblems. Choice 3000 emblems. Hook-Fast, Box 1088PS, Providence, R. I.

**START Your Own Business On Credit.** Your own boss. 1199 Dealers sold \$5,000 to \$25,000 in 1961. We supply stocks, equipment on credit. 200 home necessities. Sales experience unnecessary. Pleasant, profitable business backed by world-wide industry. Write Rawleigh, Dept. I-U-PSC, Freeport, Ill.

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**MAKE Most Extra Cash** with world's biggest line Christmas cards, wrappings, gifts. Introduce friends, neighbors to 150 Christmas, Everyday box assortments, 600 big money-making novelties. Pocket up to 50% profit plus liberal bonus. Free giant color catalog; samples on approval. Arrow Greetings, 513 Fourth Ave., T., Dept. 84-S, Minneapolis, Minn.

**BUSINESS Kit Free!** Postcard puts you in business! Complete line 230 shoe styles, jackets! New Discoveries pay Big Commissions. No investment. Send for Free Kit. Mason, Chippewa Falls K-436, Wisconsin.

**FREE Details! Big Profits!** Sell sensational new kitchen tool. Slade Gorton Co., Dept. 2K9, 96 Central Street, Boston 9, Mass.

**SELL Greeting Cards—Make extra money.** Christmas, All Occasion assortments, Stationery, Gifts, Jewelry, Name Imprinted Christmas Cards. Experience unnecessary. Saleable Samples on approval. Free Catalog. Write Hedenkamp, 361 Broadway, Dept. PS-36, New York.

**YOUR Own business—Suits \$1.50; Overcoats 65c; Mackinaws 35c; Shoes 12½c; Ladies' Coats 30c; Dresses 15c.** Enormous profits. Catalog Free. Nathan Portnoy Associates, 2109-J Roosevelt Road, Chicago 8, Ill.

**WILL You test new items in your home?** Surprisingly big pay. Latest conveniences for home, car. Send no money. Just your name. Kristes, 125, Akron, Ohio.

**NEED Extra Cash For Christmas?** Show America's finest line of gadgets, gifts, Christmas cards, wraps, toys and jewelry from colorfully illustrated catalog. Every neighbor can be a customer. Generous profits on every order you take. No selling experience needed. We send saleable merchandise on approval. For free moneymaking catalog, kit and best money making items on approval, write North Star, Dept. 2-544, 251 East Fifth Street, St. Paul 1, Minnesota.

**MAKE \$50.00** selling 25 boxes of our personalized Christmas cards, 49 exclusive designs. Free album. No obligation. Write Elmcraft, Dept. EC-14, 5930 So. Western, Chicago 36, Ill.

**SATELLITE Watches.** Soaring Satellite. Moving Stars. Lightning sellers. Dawson Imports, Fullerton, Nebraska.

## 44 HIGH-GRADE SALESMEN

**HIGH commission and bonus.** Earn \$100 to \$300 weekly. 30 Year old company has openings. List delinquent accounts for collection. Experience not necessary. Permanent. Write Merchants Protective Agency, Dept. PS9, 504 Crawford Bldg., Kansas City, Mo.

**EARN Big Commission Full or Part Time.** Build profitable business of your own selling America's largest line low priced business printing and advertising specialties. 360 page catalog samples hundreds of items used daily by business people. Imprinted ball pens low as \$7.95 for 100. Big line Low Priced Union Label Political Printing included. Free sales kit. National Press, Dept. 9, North Chicago, Illinois.

**SENSATIONAL new longer-burning Light Bulb.** Amazing Free Replacement Guarantee—never again buy light bulbs. No competition. Multi-million dollar market yours alone. Make small fortune even spare time. Incredibly quick sales. Free sales kit. Merlite (Bulb Div.), 114 E. 32nd, Dept. C-74Y, New York 16.

**MAKE extra money.** Big steady earnings, repeat business. Sell advertising Book Matches, full or part time. New 1962 line. Show Glamour Girls, Colorama, Tenoramas; dozens more. All sizes. Free Master Outfit, sales helps, leads, no experience necessary, no investment. Write today. Superior Match, Dept. P 962, 7530 Greenwood, Chicago 19.

**IF you're interested in making money in selling,** see the hundreds of exceptional opportunities in Salesman's Opportunity Magazine. Send name for your copy, absolutely free. Tell us what you're selling now. Opportunity, 848 N. Dearborn, Dept. 18, Chicago 10, Illinois.

**YOUR free copy of World's biggest sales magazine** tells you how and where to make more money on your own in selling. Write Specialty Salesman Magazine, Desk 6B, 307 North Michigan, Chicago 1.

**MAKE Extra Money** Selling advertising matchbooks. Free catalog and sales outfit. Matchcorp, Dept. PS-92, Chicago 32.

**GET New Shirt Outfit Free!** \$90 weekly on 5 average orders a day. Famous quality made-to-measure dress and sport shirts at \$4.50 up, sell to all men. No experience needed. Full or part time. Write: Packard Shirt Co., Dept. 618, Terre Haute, Indiana.

**\$1,000.00 A month for making dramatic 3-second demonstration of amazing lightweight Presto Fire Extinguisher.** New chemical used by Airforce snuffs out fires instantly. Only \$4.95. Terrific commissions. Millions want it. Free Kit. Merlite, 114 E. 32nd, Dept. P66Y, New York 16.

**UNLIMITED profit opportunity** selling unusual pocket lighter. Survey-proven. Volk Co., 30237 Euclid Ave., Wickliffe 9, Ohio.

## 45 EDUCATIONAL & INSTRUCTION

**BE A Real Estate Broker.** Insure Security for yourself and your family. Study at home. Prepare for state examination. GI approved. Write for Free Book Today. Weaver School of Real Estate, 3519R Broadway, Kansas City, Missouri.

**WOODWORKING and Cabinetmaking** course for beginning and advanced home craftsmen. Only complete low-cost home training program available. Write for free booklet. Interstate Training Service, Dept. G-2, Portland 12, Oregon.

**USED Correspondence Courses and Books** sold and rented. Money back guarantee. Catalog free. (Courses Bought.) Lee Mountain, Pisgah, Alabama.

**LEARN Civil and criminal investigation** at home. Earn steady, good pay. State age. Institute Applied Science, 1920 Sunnyside, Dept. 336, Chicago 40, Illinois.

**MASTER Watchmaking** at home. Free sample lesson. Chicago School, 2328-WJ Milwaukee, Chicago 47.

**HIGH School Diploma** at home. Licensed teachers. Approved materials. Southern States Academy, Station E-12, Atlanta, Ga.

**GOOD paying jobs open!** Operate, repair heavy earth moving equipment! Learn "on the job" operating latest cranes, bulldozers, earth carriers! V. A. Approved Free Catalog. Write K. S. Hutch, Greer Technical Institute, Braidwood, Illinois.



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**LEARN Auctioneering.** Free catalog. Missouri Auction School, 1330 Linwood, Kansas City 9—X5, Mo.

**MEN wanted.** Learn Auto-Diesel Mechanics in our shops. Learn with tools on real equipment. Earn While You Learn. Many of our graduates earn \$125 a week and up. Write for free bulletin. Auto-Diesel College, Dept. 262, Nashville 3, Tenn.

**LEARN While Asleep** with your recorder, phonograph or amazing new "Electronic Educator" endless tape recorded. Details free. Research Association, Box 24-NN, Olympia, Washington.

**BECOME Tax Consultant.** Graduates earn \$1,000-\$3,000 every tax season preparing returns evenings. State approved. Union Institute, Lakewood Q-1, N. J.

**WANT a Diesel Job? Higher Pay? Advancement?** We can help you qualify! Complete Diesel Tractor and Heavy Equipment and Cummins Diesel Engine Shop-method home-training courses available. Write today. Interstate Training Service, Dept. B-2, Portland 12, Ore.

**INTERIOR Decoration:** Approved supervised home study training. Fine starting point for career. No classes. Text and work kit furnished. Diploma awarded. Low tuition and payment. Send for free booklet. Chicago School of Interior Decoration, 835 Diversey Pkwy., Dept. 1726, Chicago 14, Ill.

**NEW self-teaching course** in memory helps you achieve greater success in business and social world. Free booklet. Memory Studies, 835 Diversey Parkway, Dept. 1726, Chicago 14.

**BOOKKEEPERS — Operate Your Own "Dollar-A-Week" System.** Ellis, Box 203, Cedar Grove, North Carolina.

**COMPLETE Your High School** at home in spare time with 65-year-old school. Texts furnished. No classes. Diploma. Information booklet free. American School, Dept. X646, Drexel at 58th, Chicago 37, Illinois.

**PIANO Tuners Average \$5.00 Hourly.** Learn With Home Study Course. Diploma Granted. American School Of Tuning, Gilroy, California.

**FINISH High School—Make More Money.** High School graduates earn more money, get better jobs. Finish School at home, in spare time. Personal help. Famous school. Write for Free Book. Wayne School, Dept. 09-521, 417 S. Dearborn, Chicago 5, Illinois.

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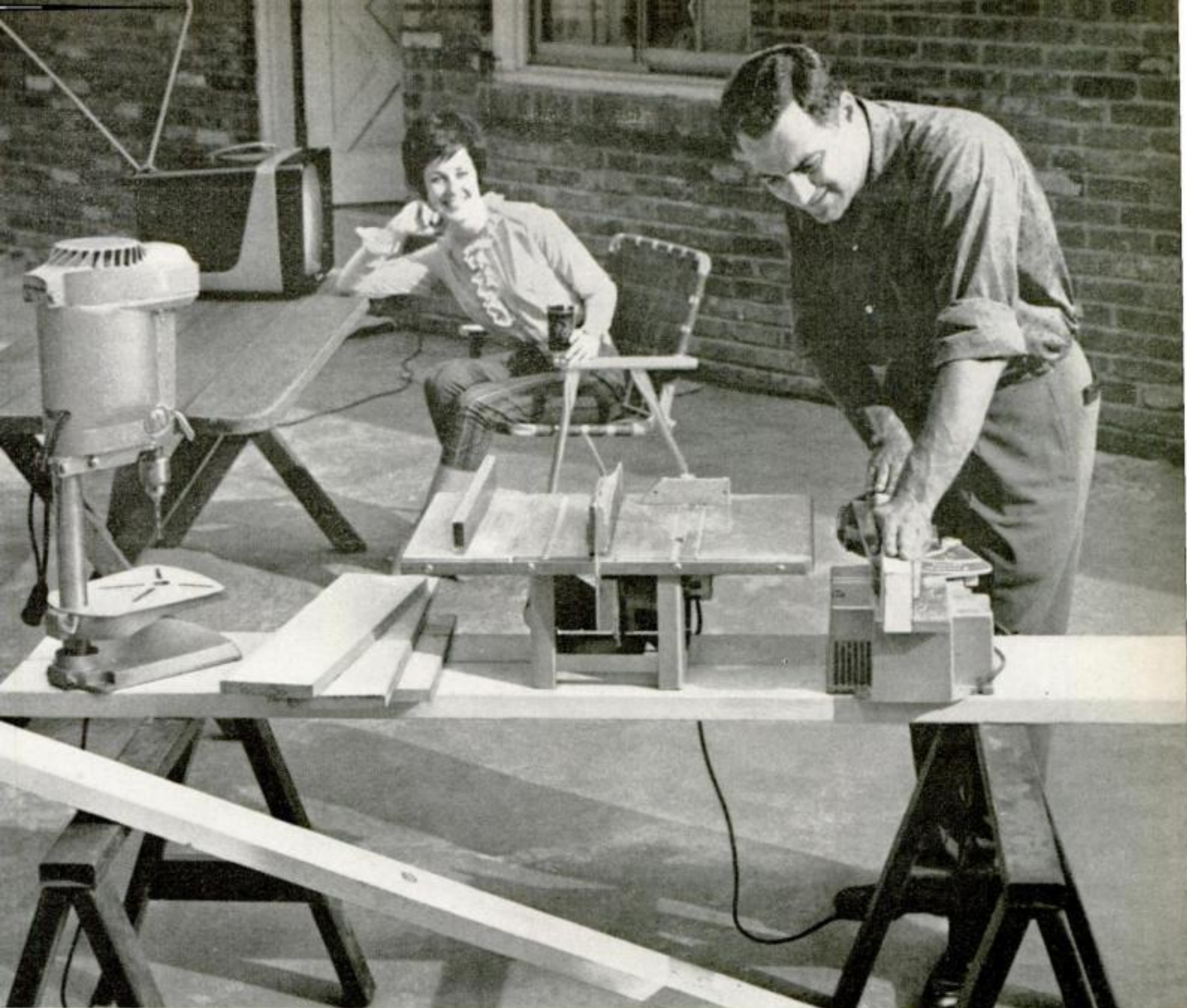
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A vintage advertisement for Chesterfield King cigarettes. The top half features a man and a woman in a romantic pose. The man, wearing a dark suit and a blue knit hat, is looking up at the woman. The woman, with blonde hair and a blue top, is holding a lit cigarette and a large RCA Victor record. The bottom half of the advertisement shows a row of 21 cigarettes and a pack of Chesterfield King Cigarettes. The pack is white with gold and blue accents, featuring the Chesterfield logo and the text '21/20'.

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